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CARLSBAD
Envision Carlsbad

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DRAFT
Climate Action Plan

March 2014

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1

Introduction

1.1 Scope and Purpose

Background and Purpose

The Climate Action Plan (CAP) is designed to reduce Carlsbad's greenhouse gas (GHG) emissions and streamline environmental review of future development projects in the city in accordance with the California Environmental Quality Act (CEQA).

The CAP has been prepared concurrently with the city's updated General Plan and includes actions to carry out the General Plan's goals and policies, consistent with the Community Vision articulated during Envision Carlsbad. The CAP is also correlated with the Environmental Impact Report (EIR) on the General Plan, with the CAP GHG reduction target synchronized with the EIR.

Community Vision and Environmental Stewardship

Carlsbad has long been a steward of environmental sustainability. In 2007, the Carlsbad City Council adopted a set of sustainability and environmental guiding principles (Resolution No. 2007-187) to help guide city investments, activities, and programs. Sustainability emerged as a key theme during the Envision Carlsbad community outreach process, and reflected as a Core Value of the Community Vision:

> ***Core Value 6: Sustainability.*** Build on the city's sustainability initiatives to emerge as a leader in green development and sustainability. Pursue public/private partnerships, particularly on sustainable water, energy, recycling, and foods.

The General Plan

The General Plan includes strategies such as mixed-use development, higher density infill development, integrated transportation and land use planning, promotion of bicycle and pedestrian movements, and transportation demand management. It also includes goals and policies to promote energy efficiency, waste reduction, and resource conservation and recycling. These strategies, goals, and policies would result in GHG reduction compared to baseline trends.

CAP

The CAP includes goals, policies, and actions for Carlsbad to reduce GHG emissions and combat climate change and includes:

- An inventory of Carlsbad's citywide and local government GHG emissions;
- Forecasts of future citywide and local government GHG emissions;
- A comprehensive, citywide strategy and actions to manage and reduce GHG emissions, with emission targets through 2035; and
- Actions that demonstrate Carlsbad's commitment to achieve state GHG reduction targets by creating enforceable measures, and monitoring and reporting processes to ensure targets are met.

The timeframe for the Plan extends from the date of adoption through 2035.

1.2 Climate Change and Greenhouse Gases Overview

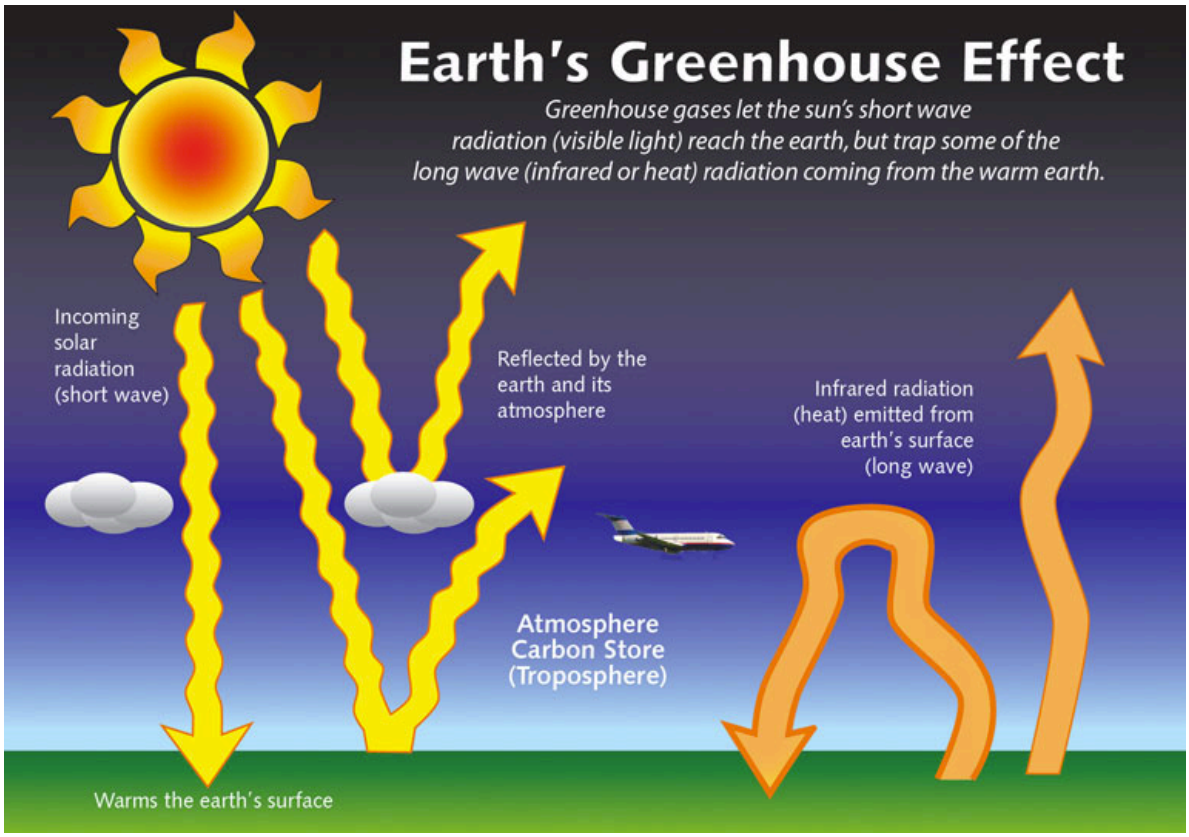
Greenhouse Effect and GHGs

Gases that trap heat in the atmosphere are often called "greenhouse gases" (GHGs). The greenhouse effect traps heat in the troposphere through a threefold process as follows: Short-wave radiation emitted by the sun is absorbed by the earth; the earth emits a portion of this energy in the form of long-wave radiation; and GHGs in the upper atmosphere absorb this long-wave radiation, emitting some of it into space and the rest back toward the earth. This "trapping" of the long-wave (thermal) radiation emitted back toward the earth is the underlying process of the greenhouse effect (Figure 1-1).

Principal GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and water vapor (H_2O). Some GHGs, such as CO_2, CH_4, and N_2O, occur naturally and are emitted to the atmosphere through natural processes and human activities. Since different gases contribute to the greenhouse effect in different proportions, the term CO_2e (carbon dioxide equivalent) provides the reference frame based on comparison to CO_2's contribution.

The greenhouse effect is a natural process that contributes to regulating the earth's temperature. Without it, the temperature of the earth would be about 0°F (–18°C) instead of its present 57°F (14°C) and unlikely to support human life in its current form.

Figure 1-1: Greenhouse Gas Effect



(Source: NYS Department of Environmental Conservation, http://www.dec.ny.gov/energy/76533.html)

Carbon Cycle and Global Temperatures

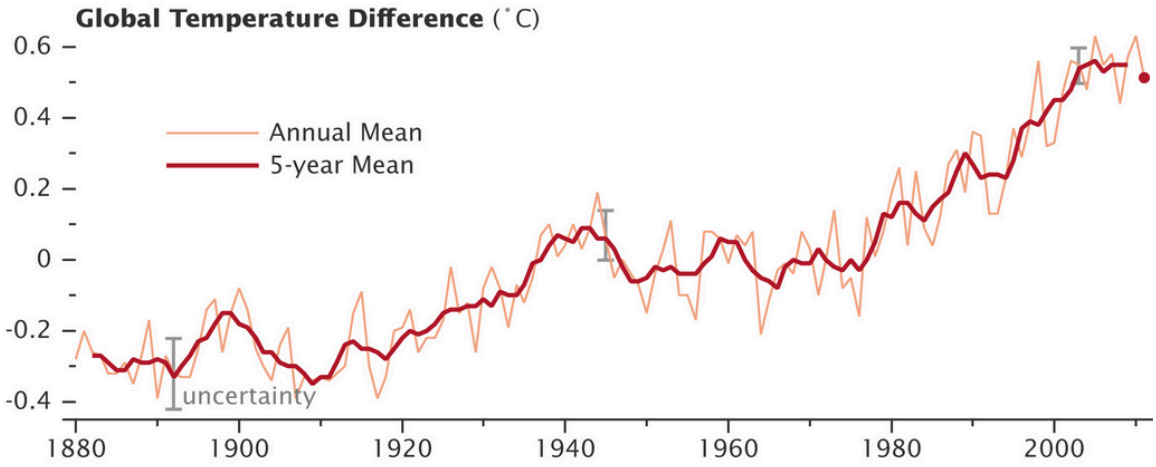
The global carbon cycle is complex and incorporates natural sources of atmospheric carbon dioxide, including respiration of aerobic organisms, wildfires, and volcanic outgassing, and sinks such the removal of CO_2 from by land plants for photosynthesis, and absorption by the ocean. Data collected on global GHG concentrations over the past 800,000 years demonstrates that the concentration of CO_2, the principal GHG, has increased dramatically since pre-industrial times, from approximately below 300 parts per million (ppm) in 1800, to about 353 ppm in 1990, 379 ppm in 2005, and 399 ppm in early 2013.[1]

Increased atmospheric concentrations of GHGs have led to a rise in average global temperatures. Figure 1-2 shows the increase in global temperatures from 1880 to 2011. While average global temperatures fluctuate on a yearly basis, the general trend shows a long-term temperature increase. Nine of the ten warmest years since 1880 have occurred since the year 2000, and scientists expect the long-term temperature increase to continue as well. The consensus among climate scientists is that earth's climate system is unequivocally warming,

[1] Source: NOAA "Trends in Atmospheric Carbon Dioxide," http://www.esrl.noaa.gov/gmd/ccgg/trends/

and rigorous scientific research demonstrates that anthropogenic[2] greenhouse gases are the primary driver.

Figure 1-2: Change in Average Global Temperatures



(Source: NASA Headquarters Release No. 12-020, http://www.nasa.gov/topics/earth/features/2011-temps.html)

Climate Change

Global climate change concerns are focused on the potential effects of climate change resulting from excessive GHGs in the atmosphere and how communities can mitigate effects and adapt to change in the short and long term.

Numerous observations document the impacts of global climate change, including increases in global average air and ocean temperatures, the widespread melting of snow and ice, more intense heat waves, and rising global average sea level. Scientists have high confidence that global temperatures will continue to rise in the foreseeable future, largely due to anthropogenic GHG emissions. In addition to the physical impacts to the environment from increased temperatures, sea level rise, and more frequent extreme weather events, global climate change is predicted to continue to cause ecological and social impacts. Ecological impacts of climate change include greater risk of extinction of species, loss of species diversity, and alteration of global biogeochemical cycles, which play an essential role in nutrient distribution. The social impacts of climate change include impacts on agriculture, fisheries, energy, water resources, forestry, construction, insurance, financial services, tourism and recreation.

According to the International Panel on Climate Change (IPCC) in North America, the regional impacts of climate change are a forecast of decreased snowpack in the western mountains, a 5 to 20 percent decrease in the yields of rain-fed agriculture in some regions,

[2] Caused by human activities

and increased frequency, intensity and duration of heat waves in cities that currently experience them.

In California, the Climate Action Team (CAT)—a group of state agency secretaries and the heads of agency, boards and departments, led by the Secretary of the California Environmental Protection Agency—synthesized current research on the environmental and economic impacts of climate change. The CAT found that climate changes are poised to affect virtually every sector of the state's economy and most ecosystems. Key findings of the CAT include predicted decreases in water supply that could cause revenue losses of up to $3 billion in the agricultural sector by 2050, increases in statewide electricity demand of up to 55 percent by the end of the century, increased wildfire risk that may cause monetary impacts of up to $2 billion by 2050, and ecosystems impacts affecting California's historic ranching culture and a source of local, grass-fed beef.

Higher temperatures, changes in precipitation, decreased water supplies accompanied by increased demand, increased risk of wildfire, a greater number of extremely hot days, the decline or loss of plant and animal species, and other impacts of climate change are expected to continue to affect Carlsbad. Climate change also has public health impacts. City residents who are already more vulnerable to health challenges are likely to be the most affected by climate change. These populations tend to be the young and the old, the poor, and those who are already sick. Increases in extreme heat events can increase the risk of heat-related illness or death, or the worsening of chronic health conditions. Food scarcity and higher food prices from impacts to agriculture can cause increased hunger and reduced availability of nutrition. The increased frequency of natural disasters such as floods, droughts, wildfires, and storm surges can cause injury or death, illness, and increases or shifts in infectious diseases.

1.3 California GHG Reduction Legal Framework

California has taken an aggressive stance to reduce GHG emissions in order to combat the impacts of climate change.

Governor's Executive Order S-3-05

Executive Order S-3-05 (EO S-3-05) recognizes California's vulnerability to increased temperatures causing human health impacts, rising sea levels, and reduced Sierra snowpack due to a changing climate. The Executive Order established targets to reduce GHG emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80 percent below 1990 levels by 2050.

Global Warming Solutions Act of 2006 and CARB Scoping Plan

The Global Warming Solutions Act of 2006 (Assembly Bill 32, or AB 32) codifies the target set in EO S-3-05 of statewide reductions to 1990 emissions levels by 2020. AB 32 directs the California Air Resources Board (CARB) to develop and implement a scoping plan and regulations to meet the 2020 target.

CARB approved the Scoping Plan in 2008, which provides guidance for local communities to meet AB 32 and EO S-3-05 targets. The Scoping Plan adopted a quantified cap on GHG

emission representing 1990 emission levels, instituted a schedule to meet the emission cap, and developed tracking, reporting, and enforcement tools to assist the State in meeting the required GHG emission reductions. The Scoping Plan recommends that local governments target 2020 emissions at 15 percent below 2005 levels to account for emissions growth since 1990, as proxy for 1990 emissions, since few localities know those levels.

The Carlsbad CAP's GHG emission targets are based on meeting the goals set in EO S-3-05 and AB 32.

1.4 Federal and State Emissions Reductions Strategies and Standards

Several federal and state standards have been adopted to reduce GHG emissions, in addition to and in support of the targets set in EO S-3-05 and AB 32.

Federal Standards

The United States Environmental Protection Agency (EPA) regulates and tests gas mileage or fuel economy in order to deter air pollution in the United States. As the transportation sector produces approximately 30 percent[3] of GHG emissions in the U.S. as a whole, fuel economy regulations are an important way to reduce GHG emissions. The EPA's Corporate Average Fuel Economy (CAFE) standards require vehicle manufacturers to comply with the gas mileage or fuel economy standards to reduce energy consumption by increasing the fuel economy of cars and light trucks. The most recent CAFE GHG emissions standards were set in 2012, which will increase the fuel economy to 54.5 miles per gallon average for cars and light trucks by Model Year 2025, and reduce U.S. oil consumption by 12 billion barrels per year. The EPA also imposes the Gas Guzzler Tax on manufacturers of new cars that do not meet required fuel economy levels, to discourage the production and purchase of fuel-inefficient vehicles.

The EPA is taking further action to reduce GHG emissions in addition to setting fuel economy standards. The EPA established a renewable fuel standard to include a minimum volume of renewable fuel in 2013, which applies to all gasoline and diesel produced or imported. On September 20, 2013, the EPA proposed the first national limits on the amount of carbon pollution that new power plants will be allowed to emit. The EPA will propose standards for existing power plants by June 1, 2014. The EPA also approved oil and natural gas air pollution standards in 2013 to reduce pollution from the oil and natural gas industry.

State Standards

California Senate Bill 375

SB 375 (2008) requires each Metropolitan Planning Organization (MPO) in the state to adopt a Regional Transportation Plan (RTP) aimed at achieving a coordinated and balance regional

[3] In 2011, GHG emissions from transportation were about 28 percent of the total 6,702 million metric tons CO_2 equivalents (Source: http://www.epa.gov/climatechange/ghgemissions/sources/transportation.html)

transportation system, including mass transit, highways, railroads, bicycles, and pedestrians, among other forms of transit. Each MPO is required to prepare a Sustainable Communities Strategy (SCS) which sets forth forecast development patterns and describes the transportation system that achieve the regional GHG emission reduction targets set by CARB.

CARB's targets for San Diego County call for the region to reduce per capita emissions 7 percent by 2020 and 13 percent by 2035 based on a 2005 baseline. There are no mandated targets beyond 2035. San Diego Association of Governments (SANDAG), the San Diego County MPO, adopted its current RTP/SCS in October 2011. The SCS lays out how the region will meet the CARB GHG targets to the year 2035. As the SCS is focused on passenger vehicle emissions on a regional scale, it is considered separate from the reductions outlined in this CAP.

Senate Bill 1368

SB 1368 creates GHG emissions performance standards for baseload generation[4] from investor-owned utilities. The bill requires that any long-term financial investment in baseload generation resources made on behalf of California customers must meet a performance standard of producing below 1,000 lbs CO_2 per MWh (megawatt-hour), approximately equal to a combined-cycle natural gas plant.

Governor's Executive Order S-1-07 (Low Carbon Fuel Standard)

Executive Order S-1-07, the Low Carbon Fuel Standard (LCFS), requires a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020. The LCFS requires oil refineries and distributors to ensure that the mix of fuel sold in California meets this reduction. The reduction includes not only tailpipe emissions but also all other associated emissions from the production distribution and use of transport fuels within the state.

Renewable Portfolio Standards

California's Renewable Portfolio Standard (RPS), established in 2002 by the California State Senate in Senate Bill 1078, accelerated in 2006 and expanded in 2011, is one of the most ambitious renewable energy standards in the country. The RPS requires each energy provider to supply electricity from eligible renewable energy resources to 33 percent of the total supply by 2020.

Pavley Fuel Economy Standards (AB 1493)

In 2009, CARB adopted amendments to the Pavley regulations to reduce GHG emissions in new passenger vehicles from 2009 to 2016. The standards became the model for the updated federal CAFE standards.

[4] Baseload generation is the minimum amount of power that a utility must make available to customers to meet minimum demands based on customer usage.

Title 24 Building Standards & CALGreen

Title 24 is California's Building Energy Code, which is updated every three years. In 2010, Title 24 was updated to include the "California Green Building Standards Code," referred to as CALGreen. CALGreen requires that new buildings reduce water consumption, increase system efficiencies, divert construction waste from landfills, and install low pollutant-emitting finish materials. CALGreen has mandatory measures that apply to nonresidential and residential construction. The most recent CALGreen code was adopted in 2013 and became effective in 2014. CALGreen contains voluntary Tier 1 and Tier 2 levels, which are designed to exceed energy efficiency and other standards by 15 percent or 30 percent.

1.5 Planning Process

How This Plan Was Prepared

The CAP reflects the city's commitment to the Core Values presented in the General Plan, and links the elements of the plan—including Sustainability; Open Space and the Natural Environment; Access to Recreation and Active, Health Lifestyles; Walking, Biking, Public Transportation, and Connectivity; and Neighborhood Revitalization, Community Design, and Livability—with the goal of GHG reduction. The CAP was prepared in 2013 by City staff and consultants, with input from the public.

On August 22, 2013 the City of Carlsbad hosted a Community Workshop on the CAP. The workshop provided an opportunity to present the citywide emissions inventory that had been completed, and discuss potential emission reduction strategies. Feedback from the Community Workshop was used to guide the preparation of this document.

Relationship to the California Environmental Quality Act

The California Environmental Quality Act (CEQA) is a statute that requires local agencies to identify significant environmental impacts of their actions and avoid or mitigate those impacts, if feasible. In 2007, California's lawmakers enacted Senate Bill (SB) 97, which expressly recognizes the need to analyze GHG emissions as part of the CEQA process. SB 97 required the Governor's Office of Planning and Research (OPR) to develop recommended amendments to address GHG emissions as an environmental effect.

In 2010, OPR's amendments to the CEQA guidelines addressing GHG emissions became effective. Lead agencies are now obligated to describe, calculate or estimate the amount of GHG emissions resulting from a project, by using a model or methodology to quantify GHG emissions resulting from a project or relying on a qualitative analysis or performance based standards. The lead agency should determine whether a project's GHG emissions significantly affect the environment by considering whether the project's emissions, as compared to the existing environmental setting, exceeds a threshold of significance that the lead agency determines applies to the project, and the extent to which the project complies with the regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions. In addition, the lead agency is required to impose feasible mitigation to eliminate or substantially reduce significant effects.

The CAP will help the city with compliance with CEQA Guidelines Section 15183.5(b): Tiering and Streamlining the Analysis of Greenhouse Gas Emissions[5], which became effective in 2010. The required elements of a CAP, as cited in the guidelines, state that a plan for the reduction of GHG emissions should:

- Quantify greenhouse gas emissions, both existing and projected over a specified time period, resulting from activities within a defined geographic area;
- Establish a level, based on substantial evidence, below which the contribution to greenhouse gas emissions from activities covered by the plan would not be cumulatively considerable;
- Identify and analyze the greenhouse gas emissions resulting from specific actions or categories of actions anticipated within the geographic area;
- Specify measures or a group of measures, including performance standards, that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level;
- Establish a mechanism to monitor the plan's progress toward achieving the level and to require amendment if the plan is not achieving specified levels;
- Be adopted in a public process following environmental review.

The CAP is intended to fulfill these requirements. The CAP also contains a Project Review Checklist, which allows for streamlined review of GHG emissions for projects that demonstrate consistency with the CAP, as described in CEQA Guidelines Section 15183.5(b).

Relationship to General Plan and Future Projects

Carlsbad's approach to addressing GHG emissions within the General Plan is parallel to the climate change planning process followed by numerous California jurisdictions. A General Plan is a project under CEQA, and projects under CEQA are required to estimate CO_2 and other GHG emissions, as described above. According to the Attorney General, "in the context of a general plan update, relevant emissions include those from government operations, as well as from the local community as a whole. Emissions sources include, for example, transportation, industrial facilities and equipment, residential and commercial development, agriculture, and land conversion." The CAP is designed to provide discrete actions to operationalize the General Plan policies that help with GHG reduction, as well as outline additional actions to help meet GHG reduction targets. The preparation of a CAP is also consistent with CEQA Guidelines Section 15183.5 that allows jurisdictions to analyze and mitigate the significant effects of GHG at a programmatic level, by adopting a plan to reduce GHG emissions.

[5] 15183.5(b) of CEQA Guidelines states, "Plans for the Reduction of Greenhouse Gas Emissions. Public agencies may choose to analyze and mitigate significant greenhouse gas emissions in a plan for the reduction of greenhouse gas emissions or similar document. A plan to reduce greenhouse gas emissions may be used in a cumulative impacts analysis as set forth below. Pursuant to sections 15064(h)(3) and 15130(d), a lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project complies with the requirements in a previously adopted plan or mitigation program under specified circumstances."

Project-specific environmental documents prepared for projects consistent with the General Plan may rely on the programmatic analysis contained in the CAP and the EIR certified for the Carlsbad General Plan. The thresholds presented in Section 5.2: Project Review and Thresholds present a clear method for determining the significance of GHG emissions for future projects.

1.6 How to Use This Plan

The CAP is intended to be a tool for policy makers, community members and others to guide the implementation of actions that limit Carlsbad's GHG emissions. Ensuring that the mitigation measures in the CAP translate from policy language to on-the-ground results is critical to the success of the CAP. Chapter 5: Project Review Checklist and Monitoring Progress describes how the city will review development projects to achieve the GHG reduction measures in Chapter 4, consistent with state CEQA Guidelines. This chapter also outlines how the city will monitor progress in reducing emissions, and periodically revisit assumptions and key provisions of the plan.

2

Emissions Inventory

This chapter identifies the major sources and the overall magnitude of greenhouse gas (GHG) emissions in Carlsbad, pursuant to Sections 15183.5(b)(1)(A) and 15183.5(b)(1)(C) of the state CEQA Guidelines. The City of Carlsbad prepared an inventory of 2005 communitywide GHG emissions, including emissions from government operations, in 2008. As part of the Climate Action Plan (CAP) preparation effort, this inventory was updated to 2011 to provide a more current measure of emissions, and is summarized in this chapter. Appendix B provides the 2005 inventory and 2011 update in detail, which is summarized in Section 2.2 in this chapter.

The inventory follows the standards developed by the International Council for Local Environmental Initiatives (ICLEI) for community and government operations GHG inventories. The inventory methodology is described first, followed by the inputs, and results.

2.1 Methodology

The community inventory covers all direct GHG emissions[6] from sources within the boundaries of the City of Carlsbad, including fuel combusted in the community and direct emissions from landfills within the community. Indirect emissions associated with the consumption of energy (such as electricity, with no end point emissions) that is generated outside the borders of the city are also included. The community inventory tallies emissions from six sectors:

- Residential;
- Commercial;
- Industrial;
- Transportation;
- Solid waste; and
- Wastewater.

[6] GHGs considered in the report are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorcarbons. The emissions have been converted to carbon dioxide equivalents (CO_2e), which converts the three other GHGs into the equivalent volume of carbon dioxide.

As the city has much greater ability to influence its own operations, the government operations inventory is presented separately, and covers direct emissions from sources the City of Carlsbad owns and/or controls. This includes mobile combustion of fuel for city vehicles and the use of natural gas to heat city buildings. Indirect emissions associated with the consumption of electricity, steam, heating or cooling for city operations that are purchased from an outside utility are also included. All other indirect emissions sources, including employee commutes and the decomposition of government-generated solid waste, are not included as part of the local government operations, but rather counted in the community inventory. The government operations inventory covers emissions from the following sectors:

- Buildings and Facilities;
- Vehicle Fleet;
- Public Lighting; and
- Water and Wastewater Transport within city borders

ICLEI's CACP[7] model is used to estimate emissions from residential, commercial, and industrial consumption of energy and solid waste disposal. The California Air Resource Board's (CARB's) EMFAC[8] models were used to calculate transportation emissions, and other sources were used for solid waste and wastewater sectors.

The majority of emissions are calculated using activity data and emissions factors. Activity data refers to a measurement of energy use or another GHG-generation process, such as residential electricity use, or vehicle miles traveled. Emissions factors are used to convert activity data to emissions, and are usually expressed as emissions per unit of activity data (e.g. metric tons carbon dioxide [CO_2] per kilowatt hour of electricity). To estimate emissions, the following basic equation is used:

$$[\textit{Activity Data}] \; x \; [\textit{Emissions Factor}] = \text{Emissions}$$

As an example, multiplying the total amount of residential electricity use (activity data, expressed in kilowatt-hours) by the emissions factor (expressed as CO_2e emissions per kilowatt-hour) produces the emissions in CO_2e from residential energy use. The following section describes the inputs for the community inventory based on activity data (or usage).

Certain emissions that occur in the city are not counted in the community inventory. For example, during the community workshop on the CAP some participants questioned why emissions related to the Encina Power Plant are not included in Carlsbad's GHG inventory. The reason is as follows: embodied emissions, such as those resulting from power generation that is produced locally but distributed regionally, are not covered in Carlsbad's inventory, in accordance with ICLEI standards. These emissions are included at the points where energy is

[7] Clean Air and Climate Protection (CACP) is a model developed by ICLEI to inventory and forecast GHG emissions. The 2011 update utilized the CACP 2009 Version 3.0 software.

[8] The Emissions Factors (EMFAC) model was developed by CARB to measure various emissions from vehicles. There are multiple versions of EMFAC which focus on different vehicle types.

consumed (some of which are in Carlsbad) rather than where it is simply *produced*—otherwise emissions would either be double counted, or if only counted at the production source, electricity consumption (which is the second largest contributor to GHG) in climate action planning would be meaningless. Similarly, for water consumed in Carlsbad, emissions associated with its transport from Northern California and Colorado are counted in Carlsbad's inventory, rather than elsewhere.

The Carlsbad Desalination Plant, which will begin operations in 2016, would therefore not contribute emissions to the 2011 GHG inventory. The emissions forecast (Chapter 3) uses a regional average for water consumption emissions, which accounts for the effect of the desalination plant. In general, including these large regional facilities would effectively add GHGs from consumption of services outside of Carlsbad to the city's emission totals.

The McClellan-Palomar airport is county owned and operated, and is outside of the city's jurisdiction. The city has little, if any, influence over airport operations, and emissions associated with airport flight operations are excluded because they occur in a regional context.

For transportation trips that originate or end in Carlsbad, emissions for half of the entire trip are included, and not just for the miles traveled within Carlsbad; however, trips that just pass through Carlsbad are excluded, as their emissions would be reflected at their trip ends.[9] Furthermore, although pass-through trips contribute a substantial amount to VMT totals, the city and Carlsbad community has limited ability to influence them.

2.2 Community Inventory

Residential, Commercial, and Industrial (RCI) Electricity and Natural Gas Usage

The inputs for the CACP model for the residential, commercial and industrial (RCI) sectors are electricity and natural gas consumed. Table 2-1 shows RCI electricity and natural gas consumption, and the total citywide consumption of electricity and natural gas. The commercial sector has the largest electric consumption followed by residential and industrial. The greatest natural gas consumption is from the residential sector, used for heating homes and water, followed by commercial and industrial sectors.

TABLE 2-1: RESIDENTIAL, COMMERCIAL AND INDUSTRIAL (RCI) INPUTS; 2011

		Inputs
Residential	Electric (kWh)	275,033,189
	Natural Gas (therms)	15,769,481
Commercial	Electric (kWh)	411,249,580

[9] For example, for a trip that begins in downtown San Diego and ends in Carlsbad, the entire trip length is calculated for that trip. Half of the entire trip length is assigned to Carlsbad, and the other half is assigned to the City of San Diego. Using half the trip length is standard SANDAG methodology for assigning regional VMT to a particular city.

TABLE 2-1: RESIDENTIAL, COMMERCIAL AND INDUSTRIAL (RCI) INPUTS; 2011		
		Inputs
	Natural Gas (therms)	7,844,336
Industrial	Electric (kWh)	116,341,521
	Natural Gas (therms)	1,536,470
Total by Source		
Electricity (kWh)		802,624,290
Natural Gas (therms)		23,613,817

Source: SDG&E, 2013

Differing emissions based on the source of electricity, either bundled or direct access electricity, were taken into account. Bundled electricity is produced for SDG&E and transmitted by SDG&E. Direct access electricity is produced elsewhere in the region but ultimately transmitted to the consumer by SDG&E. Natural gas produces CO_2e regardless of source.

Transportation

Transportation emissions are based on vehicle miles traveled (VMT) for vehicles and off-road equipment. GIS-based 2011 VMT data from SANDAG for all roadways was used. All roadways including the zone connectors were used. The SANDAG data is reported as daily weekday VMT. This was converted to annual VMT by multiplying it by 347[10], as recommended by CARB. The total annual VMT in 2011 was 510,973,969 vehicle miles traveled.

CARB's latest model, EMFAC2011, is made up of three modules: -SG, -LDV, and –HD. The SG module covers all vehicle types, while LDV calculates light duty vehicles and HD calculates heavy duty vehicles. Appendix B provides a more detailed explanation of how CO_2e were calculated using each module. As inputs, emissions from local roadway VMT and freeway VMT were determined separately.

Off-road emissions in Carlsbad include lawn and garden equipment, construction equipment, industrial equipment, and light commercial equipment. While CARB's OFFROAD2007 model generates emission outputs for 16 categories across San Diego County, only the off-road emissions listed above are included, as they generate the most emissions in Carlsbad in this category. The CO_2, N_2O, and CH_4 emissions were calculated in short tons per day for the county. These emissions were then pro-rated by the city's share of the county population, multiplied by 365 days, and converted to metric tons.

Solid Waste

The default values in the CACP were used for solid waste emissions. For methane emissions from the one landfill in the city limits—the closed Palomar Airport Landfill—the same data

[10] CARB recommends that 347 be used instead of 365 to convert from average daily VMT to annual VMT to account for less travel on weekends.

from the 2005 community inventory was used, as it was unlikely to have changed substantially, if at all.

For emissions from solid waste disposed of in Carlsbad and taken to landfills elsewhere, 2011 data for Carlsbad was obtained from CalRecycle. The composition of waste was estimated from the latest such survey, the 2008 CalRecycle Statewide Waste Characterization Study, which has averages for the southern region of California. The amount of average daily cover, which is made of plant debris, was also entered.

Wastewater Treatment

Emissions from methane and nitrous oxide generated in the process of wastewater treatment were determined using the University of San Diego's EPIC (Energy Policy Initiatives Center) model. The EPIC estimate of GHG emissions from countywide wastewater treatment was used and pro-rated to Carlsbad's share of the county population.

Total Community Emissions

The total community GHG emissions were 705,744 $MTCO_2e$ in 2011. Table 2-2 summarizes the sources and quantities of community emissions, and Figure 2-1 shows the emissions graphically by sector. The largest sector is transportation, at 39 percent, followed by commercial and industrial (32 percent), residential (25 percent), solid waste (3 percent) and wastewater (1 percent).

Figure 2-1: 2011 Community GHG Emissions by Sector (MTCO2e)

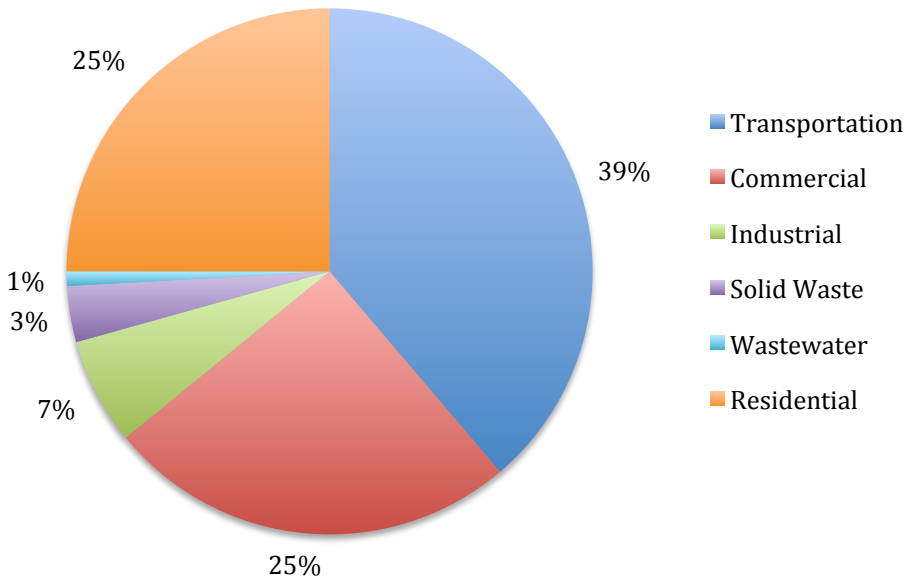
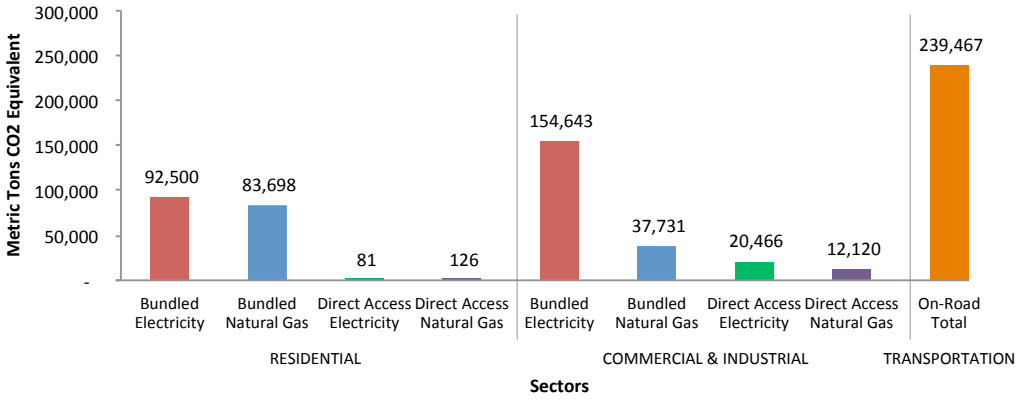


TABLE 2-2: 2011 COMMUNITY GHG EMISSIONS ($MTCO2_e$)		
Sector	**Subsector**	**Emissions**
	Bundled Electricity	92,500
	Bundled Natural Gas	83,698
	Direct Access Electricity	81
	Direct Access Natural Gas	126
Residential	**Total Residential**	**176,405**
	Bundled Electricity	125,314
	Bundled Natural Gas	37,731
	Direct Access Electricity	11,701
	Direct Access Natural Gas	3,966
Commercial	**Total Commercial**	**178,712**
	Bundled Electricity	29,329
	Bundled Natural Gas	-
	Direct Access Electricity	8,765
	Direct Access Natural Gas	8,154
Industrial	**Total Industrial**	**46,248**
	On-Road Total	*239,467*
	Lawn and Garden Equipment	2,449
	Construction Equipment	23,830
	Industrial Equipment	4,943
	Light Commercial Equipment	3,056
	Off-Road Subtotal	*34,279*
Transportation	**Total Transportation**	**273,745**
	Community-generated solid waste	21,719
	Landfill Waste-in-Place	2,598
Solid Waste	**Total Solid Waste**	**24,317**
Wastewater	**Total Community-generated Wastewater**	**6,317**
GRAND TOTAL		**705,744**

Figure 2-2 shows the emission by source for the three largest sectors: residential, commercial and industrial, and transportation. The largest individual sources are on-road transportation, bundled commercial and industrial electricity, and bundled residential electricity.

Figure 2-2: 2011 Community GHG Emissions by Source for Three Largest Sectors (MTCO2e)



Emissions By Source

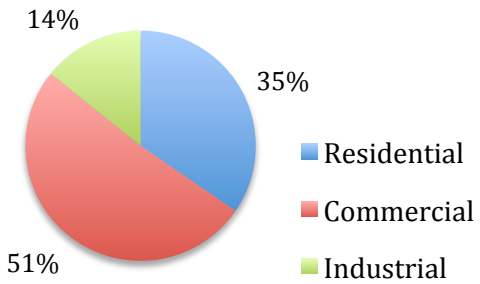
Electricity

Electricity emissions account for 38 percent of the total emissions. Table 2-3 and Figure 2-3 show electricity use by sector—commercial sector consumes more than half of all electricity in Carlsbad, followed by residential sector, which accounts for just over a third of total electricity use.

TABLE 2-3: ELECTRICITY EMISSIONS BY SECTOR ($MTCO_2E$)

Sector	2011 Emissions
Residential	92,581
Commercial	137,015
Industrial	38,093

Figure 2-3: Electricity Emissions by Sector



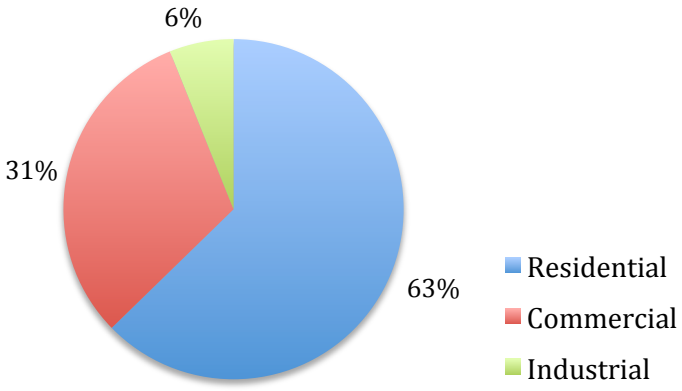
Natural Gas

Natural gas use accounts for 19 percent of total emissions in Carlsbad. The residential sector accounts for 63 percent of natural gas use, while the commercial sector accounts for 31 percent. Table 2-4 and Figure 2-4 show natural gas use emissions by sector.

TABLE 2-4: NATURAL GAS EMISSIONS BY SECTOR ($MTCO_2e$)

Sector	2011 Emissions
Residential	83,824
Commercial	41,697
Industrial	8,154

Figure 2-4: Natural Gas Emissions by Sector



Change Between 2005 and 2011 Community Emissions

Total community emissions in 2005 were 630,310 $MTCO_2e$ compared with 705,744 in 2011. The increase in total GHG emissions of 12 percent in the period parallels the population and jobs increase, as well as the service population increase (the number of residents plus number of jobs). While total GHG emissions have increased, emissions per service population (population plus workers) have held steady since 2005. Table 2-5 summarizes these changes.

TABLE 2-5: POPULATION AND JOBS, 2005 AND 2011			
	2005	2011	% Change
Carlsbad Population[a, b]	94,961	106,403	12.0%
Carlsbad - # of Jobs[c]	59,309	66,417	12.0%
Carlsbad – Service Population[d]	154,270	172,820	12.0%
GHG Emissions ($MTCO_2e$)	630,310	705,744	12.0%
Emissions per Service Population	4.09	4.08	-0.1%

a. 2011 population from the California Department of Finance, Table E-5.

b. The 2005 Inventory used different populations for the community and local government analyses. This is the population used for the community inventory.

c. Numbers from SANDAG.

d. The service population is the total number of residents plus workers

Table 2-6 shows the source of growth in emissions. The largest increase in emissions came from commercial electricity usage (37% of increase), followed by residential electricity usage (29%). All other emissions increased at a slower pace than the rate of population growth, with emissions from residential natural gas consumption increasing by 9 percent, and all other sources increasing by 5 percent, or decreasing, in the case of roadway emissions.

For electricity, the increase was largely caused by the increase (35%) in the CO_2 generated by SDG&E electricity since 2005. For example, residential electricity consumption increased by 10 percent but emissions from that source increased by 29 percent. Commercial electricity consumption went up by 8 percent while related emissions increased by 37 percent—an even higher increase as some commercial customers in the greater San Diego region switched from cleaner direct access electricity to sources producing more CO_2.

TABLE 2-6: SOURCES OF GROWTH IN GHG EMISSIONS (METRIC TONS CO2E)				
Source	2005 CO2e	2011 CO2e	Growth	% of Growth
Commercial-Electric	98,352	137,015	38,663	37%
Residential-Electric	62,290	92,581	30,291	29%
Residential-NG	74,137	83,824	9,688	9%
Roads	260,467	239,467	-21,000	-8%
Industrial-Electric	32,417	38,093	5,676	5%
Commercial-NG	36,259	41,697	5,438	5%
Off Road	28,963	34,279	5,315	5%
Industrial-NG	3,013	8,154	5,141	5%
Wastewater	4,397	6,317	1,920	2%
Solid Waste	30,015	24,317	-5,698	-5%
TOTAL	**630,310**	**705,744**	**75,434**	

Table 2-7 shows the sources of emissions, ordered by volume of overall contribution. The largest contributor continues to be transportation, but that has declined in proportion as emissions from building energy consumption have grown faster. These sources—roadway VMT, off-road vehicles, and private electricity and natural gas consumption—account for 96 percent of Carlsbad's communitywide GHG emissions.

TABLE 2-7: GREENHOUSE GAS EMISSIONS SUMMARY BY SECTOR (METRIC TONS CO2E)

Sector	2005	% of Total	2011	% of Total
Transportation	289,431	46%	273,745	39%
Commercial / Industrial	170,041	27%	224,960	32%
Residential	136,427	22%	176,405	25%
Solid Waste	30,015	5%	24,317	3%
Wastewater	4,397	1%	6,317	1%
TOTAL	**630,310**		**705,744**	

2.3 Government Operations Inventory

Government operations represent a small portion (1.2%; see end of this section) of the communitywide GHG emissions. However, more detailed information is available to characterize GHG emissions by source and sector. The city has the ability to directly influence emissions from government operations, and can provide community leadership in reducing GHG emissions. As described before, the four sectors included in the government operations inventory are buildings and facilities, vehicle fleet, public lighting, and water and wastewater transport.

Buildings and Facilities

The inputs for this sector are electricity and natural gas. Data was entered by individual facility along with departmental information. Table 2-8 lists all of the buildings and facilities operated by the city and electricity and natural gas inputs.

TABLE 2-8: BUILDINGS AND FACILITIES INPUTS; 2011

Department	Building	Electricity (kWh)	Natural gas (therms)
City	City Administration	1,203,726	1,738
City	City Hall	233,680	5,313
City	Farmers Insurance Bldgs	112,057	-
City	Hawthorne Equipment Bldg	10,040	-
City Total		**1,559,503**	**7,051**
Community Development	Hiring Center	6,972	-
Community Development	Las Palmas	55,570	-

TABLE 2-8: BUILDINGS AND FACILITIES INPUTS; 2011			
Department	**Building**	**Electricity (kWh)**	**Natural gas (therms)**
Community Development Total		**62,542**	
Fire	Fire Station No. 1	63,600	1,358
Fire	Fire Station No. 2	32,643	1,069
Fire	Fire Station No. 3	33,972	675
Fire	Fire Station No. 4	28,867	1,062
Fire	Fire Station No. 5	98,720	2,061
Fire	Fire Station No. 6	55,180	1,464
Fire Total		**312,982**	**7,689**
Golf Course	The Crossings	**1,056,015**	**18,019**
Library	Cole Library	430,160	2,119
Library	Cultural Arts Department	14,444	321
Library	Dove Library	1,432,492	11,200
Library	Library Learning Center	192,000	421
Library Total		**2,069,096**	**14,061**
PD/Fire	Safety Center	**988,001**	**19,816**
Public Works	City Yard	88,335	729
Public Works	CMWD M&O	189,440	86
Public Works	Fleet Yard	72,320	456
Public Works	Parks Maintenance	39,694	149
Public Works Total		**389,789**	**1,420**
Recreation	Calavera Community Center	54,970	-
Recreation	Carrillo Ranch	58,080	-
Recreation	Harding Community Center	60,120	952
Recreation	Parks Total	914,888	3,006
Recreation	Senior Center	308,318	3,349
Recreation	Stagecoach Community Center	195,920	1,424
Recreation	Swim Complex	247,240	34,266
Recreation	Trails	65,929	-
Recreation Total		**1,905,465**	**42,997**
Housing and Neighborhood Services		**31,277**	**-**
TOTAL		**8,374,670**	**111,053**

VEHICLE FLEET

The inputs for this sector are all vehicles used by the city. The key data used are fuel consumed and VMT, broken out by model year, vehicle type, and fuel type. CACP uses fuel consumption to calculate CO_2 emissions and VMT to calculate NO_2 and CH_4 emissions.

Although the vehicle fleet data from the city was broken down by department, the inputs were loaded into CACP as a single set for the entire city due to the time-consuming nature of processing and entering this very detailed information.

Table 2-9 summarizes the inputs by vehicle and fuel type. Gasoline accounted for the largest amount of fuel consumption (167,345 gallons) and greatest vehicle miles traveled (1,965,416 VMT).

TABLE 2-9: GOVERNMENT OPERATIONS VEHICLE FLEET INPUTS

	2011	
	Fuel (gal)	VMT
Diesel	**62,407**	**407,826**
Light Truck/SUV/Pickup	31,162	298,388
Heavy Truck	31,245	109,438
Gasoline	**167,345**	**1,965,416**
Light Truck/SUV/Pickup	76,663	938,733
Passenger Car	85,874	931,979
Motorcycle	1,787	74,024
Heavy Truck	3,021	20,680
Hybrid	**3,581**	**137,096**
Passenger Car	2,478	108,136
Light Truck/SUV/Pickup	1,103	28,960

For the analysis in CACP, motorcycle inputs were grouped under passenger cars and hybrid fuel consumption was included with gasoline. Hybrid VMT was assumed at one-third of listed mileage to account for the likely reality of most hybrid miles being under electric power during low speed driving on local streets.

Public Lighting

This sector covers electricity consumed from three sources: traffic signals, streetlights, and other outdoor lighting. As shown in Table 2-10, streetlights make up the great majority of electricity consumption in this sector. Between 2005 and 2011, the city retrofitted its existing streetlights with more energy-efficient lamps.

TABLE 2-10: PUBLIC LIGHTING INPUTS (KWH)

	2011	% of Total
Streetlights	4,403,265	85%
Traffic Signals/Controllers	768,784	15%
Outdoor Lighting	17,740	<1%
TOTAL	**5,189,789**	

Water and Wastewater Transport

This sector covers fuel consumed by pumps and other mechanisms used to convey water and wastewater: water delivery pumps, sprinklers and irrigation, sewage pumps, and recycled water pump stations. These systems all consumed electricity plus a small amount (170 gallons) of diesel fuel for water delivery generators.

Table 2-11 shows the electricity consumed by the city's water and wastewater transport systems in 2011. The greatest electricity consumption is from sewage pumps (53 percent), followed by recycle pump stations (34 percent), water delivery pumps (12 percent), and sprinklers and irrigation (1 percent).

TABLE 2-11: WASTE AND WASTEWATER TRANSPORT INPUTS (KWH)

	2011	% of Total
Sewage Pumps	1,262,824	53%
Recycle Pump Stations	791,732	34%
Water Delivery Pumps	285,345	12%
Sprinklers/Irrigation	22,554	1%
TOTAL	**2,362,455**	

Inventory Results

Emissions by Sector

Government operations in 2011 generated an estimated 8,205 metric tons CO_2e in GHG emissions, as shown in Table 2-12. Emissions for government operations mainly came from buildings and facilities (42%) and the vehicle fleet (27%), followed by public lighting (21%) and water and wastewater transportation (10%).

TABLE 2-12: GOVERNMENT OPERATIONS EMISSIONS BY SECTOR ($MTCO_2E$)

Source	2011	% of Total
Buildings and Facilities	3,410	42%
Vehicle Fleet	2,253	27%
Public Lighting	1,747	21%
Water and Wastewater Transport	795	10%
TOTAL	**8,205**	

Emissions by Source

Most of the government operations emissions came from electricity consumption, accounting for 65 percent of emissions, as shown in Table 2-13. Gasoline produced about 19 percent of emissions, followed by diesel/propane (8 percent), natural gas (7 percent) and mobile refrigerants (1 percent).

TABLE 2-13: EMISSIONS BY SOURCE ($MTCO_2E$)

Source	2011	% of Total
Electricity	5,362	65.4%
Gasoline	1,538	18.7%
Diesel / Propane	641	7.8%
Natural Gas	590	7.2%
Mobile Refrigerants	74	0.9%
TOTAL	**8,205**	

Comparison of Government Operations to Citywide Emissions

Table 2-14 shows a comparison of the government operations to citywide emissions. Government operations account for a very small portion of GHG emissions in 2011, comprising about 1.2 percent of emissions.

TABLE 2-14: GOVERNMENT OPERATIONS EMISSIONS VS COMMUNITY EMISSIONS ($MTCO_2E$)

	2011
Government operations emissions	8,205
Community emissions	705,744
Government operations as proportion of community emissions	1.2%

3

Greenhouse Gas Reduction Target, Forecasts, and Emissions "Gap"

This chapter describes the greenhouse gas (GHG) reduction targets provided by state law, provides a baseline forecast of community GHG emissions, and models forecasts of future community and local government GHG emissions through 2035. The chapter also quantifies GHG reductions from (1) state and federal actions and (2) the updated Draft General Plan policies and actions, and applies these reductions to the community forecast. The emissions "gap" between the forecasts (with GHG reductions) and the emissions targets is addressed by the Climate Action Plan (CAP) GHG reduction strategies in Chapter 4.

3.1 GHG Reduction Target

Governor's Executive Order S-3-05 and the Global Warming Solutions Act of 2006

Executive Order S-3-05 (EO S-3-05) and the California Global Warming Solutions Act of 2006 (AB 32) provide the basis for the CAP's GHG emissions targets. EO S-3-05 commits California to reduce its GHG emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050. AB 32 codifies the 2020 target and tasks CARB with developing a plan to achieve this target.

CARB first approved the Scoping Plan in 2008, which provides guidance for local communities to meet AB 32 and EO S-3-05 targets. The Scoping Plan recommends that local governments target 2020 emissions at 15 percent below 2005 levels to account for emissions growth since 1990, as proxy for 1990 emissions, since few localities know those levels.

Total Carlsbad GHG emissions from the 2005 inventory were 630,310 metric tons carbon dioxide equivalents ($MTCO_2e$) per year. Therefore, the 2020 target under State guidance is a 15 percent reduction from 2005 emissions, which corresponds to a target of 535,763 $MTCO_2e$.

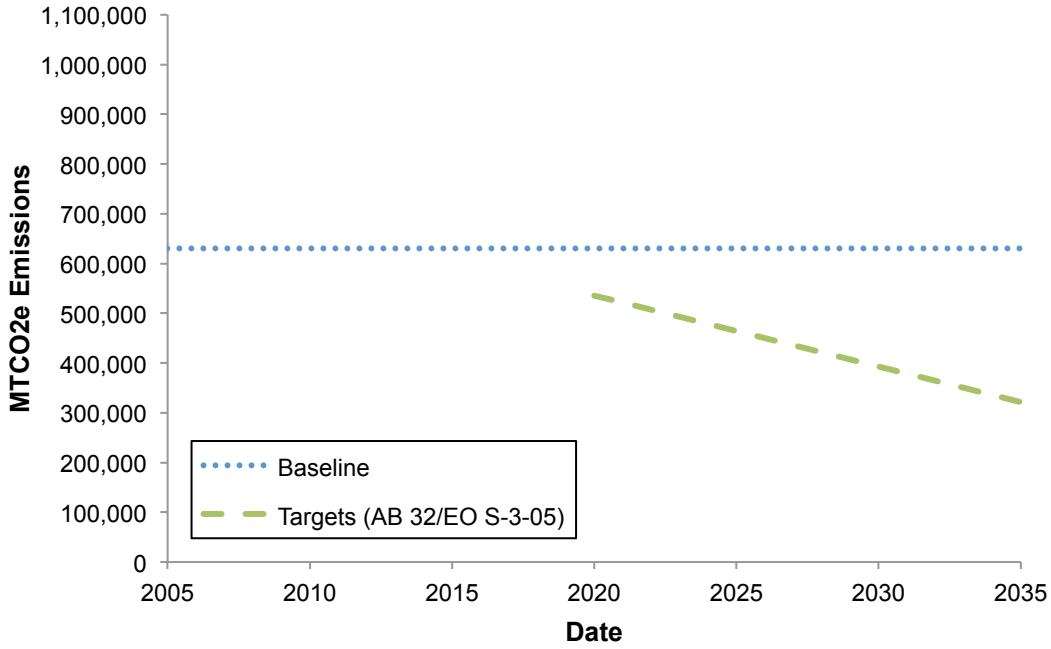
The long range 2050 target set by EO S-3-05 is an 80 percent reduction from 2020 emissions target, which represents the level scientists believe is necessary to stabilize the climate. The 2050 target for Carlsbad is citywide emissions of 107,153 $MTCO_2e$. This is a substantial decrease in overall emissions, over 500,000 $MTCO_2e$ below baseline 2005 emissions levels. While CARB's Scoping Plan does not specifically set target levels for intermediate years between 2020 and 2050, the Scoping Plan recommends a linear progression in annual GHG emissions reductions to meet the final targets.

The horizon year for this CAP is 2035, corresponding with the Draft General Plan horizon. The CAP uses a linear trajectory in emissions reductions between 2020 and 2050 to determine the 2035, target. Table 3-1 summarizes these emissions targets and the percentage reduction from 2005 emissions. Figure 3-1 graphs the emissions targets, following a linear trajectory, from 2020 to 2035. As can be seen, the baseline exceeds the 2020 reduction target by 15 percent, and the 2035 target by 49 percent.

TABLE 3-1: 2005 EMISSIONS AND EMISSIONS TARGETS

Year	GHG Emissions and Targets	Reduction From 2005 Baseline
2005	630,310 $MTCO_2e$	N/A
2020	535,763 $MTCO_2e$	15 percent
2035	321,458 $MTCO_2e$	49 percent

Figure 3-1: 2005 Emissions and Emissions Targets

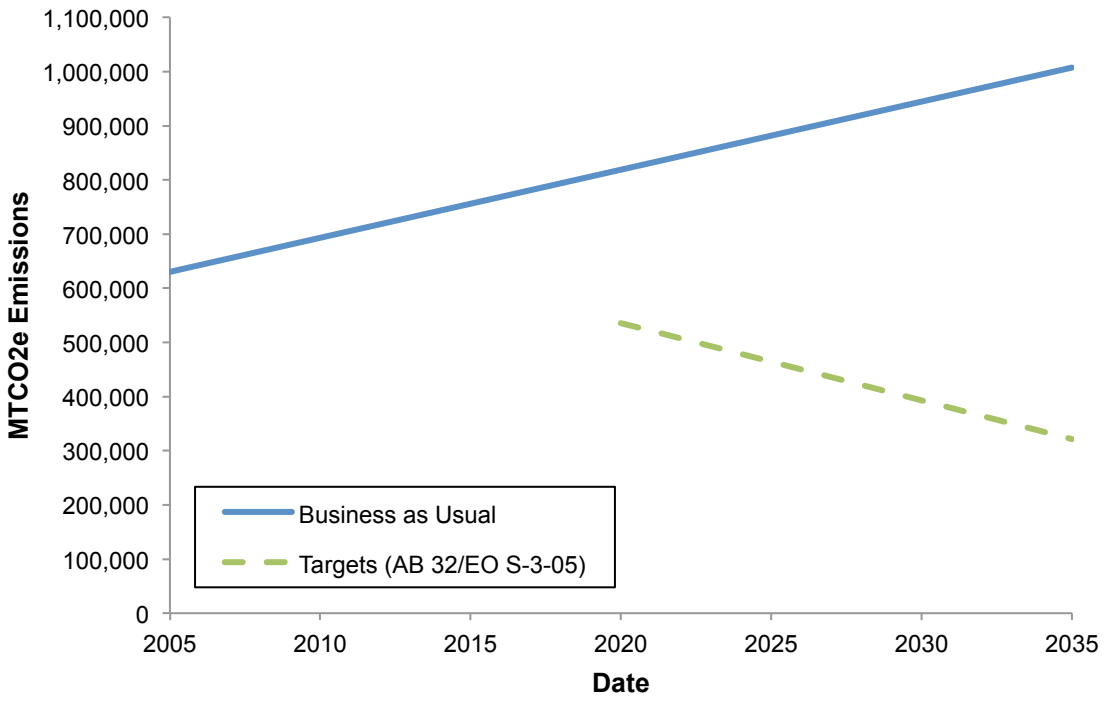


3.2 Business as Usual Forecast

The business as usual (BAU) forecast estimates emissions through the year 2035, based on the growth in emissions from the 2005 to 2011 citywide inventory. The increase in community emissions from 2005 to 2011 was linearly projected outward to the year 2035. The BAU forecast simply assumes that emissions will increase in the future at the same growth rate that occurred between the 2005 and 2011 citywide inventories. Thus, BAU emissions are forecast to reach 1,007,473 $MTCO_2e$ in the year 2035.

Figure 3-2 shows the difference between emissions under the business as usual forecast and the 2020 and 2035 emissions targets.

Figure 3-2: Business as Usual Forecast and Emissions Targets



3.3 Community Forecast with General Plan Land Use and Circulation System

Methodology

The Statewide Energy Efficiency Collaborative model (SEEC) is used to predict community GHG emissions across all sectors to 2035. A product of the collaborative, this tool is based on the International Council for Environmental Initiatives' (ICLEI's) Clean Air and Climate Protection (CACP) model used to estimate the 2005 and 2011 emissions inventories. The primary reason for using SEEC rather than CACP is that SEEC includes the effects of the Renewable Portfolio Standard (RPS) and Pavley I Fuel Economy Standards, whereas CACP requires manual adjustment to account for the state-mandated electrical production and fuel efficiency improvements. Section 3.4 quantifies other state and federal actions that reduce GHG emissions and incorporates these actions into the forecast.

The SEEC community forecast predicts all direct GHG emissions[11] from sources within the boundaries of the City of Carlsbad, including fuel combusted in the community[12] and direct emissions from landfills within the community. Indirect emissions associated with the consumption of energy that is generated outside the borders of the city are also included. Other indirect or embodied emissions are not covered in the forecast, in accordance with ICLEI standards. The SEEC community forecast tallies emissions from seven sectors:

- Residential
- Commercial
- Industrial
- Transportation
- Solid Waste
- Landfills[13]
- Wastewater

The emissions projected in the SEEC community forecast use the activity data (or usage) from the 2005 community inventory as an initial value, and the 2011 inventory to provide an intermediate value to adjust the model. The predicted growth in each sector is then added into the model to project future emissions. The following section describes how the predicted growth in each section was determined.

[11] GHGs considered in the report are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorcarbons. The emissions have been converted to carbon dioxide equivalents (CO_2e), which converts the three other GHGs into the equivalent volume of carbon dioxide.

[12] This does not include the Encina Power Station, for reasons described in Chapter 2.

[13] The 2011 inventory considered landfill emissions as part of solid waste. The SEEC model separates out landfills from solid waste as an emissions source, so the separation has been preserved in this chapter.

Inputs

Residential

Emissions from the residential sector are from electricity and natural gas demand. The growth in residential electricity and natural gas consumption was assumed to scale with population growth, estimated at 0.9 percent per year thorough 2035, based on General Plan buildout estimates.

Commercial

The increase in commercial demand for electricity and natural gas was assumed to scale with the General Plan employment forecasts to 2035 in the commercial sector by land use category: commercial, hotel, office, and other, including construction and transportation-related employment. For 2010 to 2035, an annual growth of 1.1 percent was used.

Industrial

The growth rate in industrial electricity and natural gas demand was based on General Plan employment forecasts to 2035 in the industrial sector. An annual growth rate of 0.8 percent was used through 2035.

Transportation—With General Plan Land Use and Circulation System

Transportation emissions are based on the emissions associated with VMT. The VMT projections were taken from SANDAG GIS models of regional VMT projections clipped to the city boundaries and adjusted to remove through trips, or trips that did not originate nor end within city boundaries.[14] The SANDAG data was reported as daily weekday VMT. This was converted to annual VMT by multiplying it by 347[15], as recommended by CARB.

The VMT forecasts incorporate GHG reductions from General Plan land use projections and new roadway construction thorough 2035. These VMT forecasts reflect the General Plan land use patterns, include the effects of compact and infill, mixed-use, and transit-oriented development, and the protection of open space. New roadway construction includes the effects of street extensions and citywide traffic signalization. The land use projections and new roadway construction are described in detail in the General Plan.

The SEEC model automatically incorporates the effect of Pavley I Fuel Economy Standards. Table 3-2 shows the citywide VMT for 2011 and projected VMT forecast, used to estimate transportation emissions.

[14] Excluding through trips removes much of the regional traffic through the Interstate 5 Freeway.

[15] 347 was used instead of 365 to average out the effect of a dip in traffic during the weekend.

TABLE 3-2: 2011 VMT AND PROJECTED 2020 AND 2035 VMT[16]

Year	Vehicle Miles Traveled
2011	510,973,969
2020	560,972,562
2035	651,739,086

Solid Waste

Waste emissions from solid waste disposed of in Carlsbad and taken to landfills elsewhere, was assumed to scale with population growth at 0.9 percent per year through 2035.

Landfill

Emissions from the landfill sector are an estimate of methane generation from the anaerobic decomposition of all organic waste sent to a landfill. Within city boundaries, landfill emissions are comprised of leaking methane from the closed Palomar Airport Landfill. Currently, most of the methane generated at this capped landfill is captured. The EPA estimates 95 percent methane capture rate for capped landfills and estimates that emissions follow a first-order exponential decay. Therefore, baseline landfill emissions were estimated to decrease exponentially over time, at a decay rate of 5 percent over 10 years to 2035, the largest allowed percentage decrease in the model.

Wastewater

The Carlsbad Municipal Water District's 2010 Urban Water Management Plan (UWMP) was used to determine the growth in emissions from wastewater treatment.[17] The demand for wastewater treatment was assumed to scale with projected 2035 water deliveries listed in the UWMP. The UWMP includes the effect of conservation policies. Table 3-3 shows water deliveries and annual growth rates used in the forecast.

[16] VMT includes the effect of an additional 327 units above the growth cap in the Northwest Quadrant by 2035, as shown in the 2014 Draft General Plan. While the City Council will adjust housing sites or densities at adoption time so that the development cap is not breached, the inclusion of these units in the CAP represents a conservative estimate that leads to a slightly higher VMT (and corresponding GHG emissions) above levels anticipated under General Plan that would be adopted.

[17] Carlsbad Municipal Water District serves the majority of the city, with the exception of the southeast corner of the City, which is served by Olivehaven Municipal Water District, and Vallecitos Water District. The changes in water demand from the UWMP were assumed to be representative of the city as a whole for the purposes of the SEEC model.

TABLE 3-3: PROJECTED UWMP WATER DELIVERY, USED TO DETERMINE WASTEWATER EMISSIONS

Year	Water Delivery (acre-feet per year, all sectors)	Annual Percentage Growth
2005	19,759	-
2010	15,076	-5.3%
2020	20,529	3.1%
2030	21,147	0.3%
2035	22,122	0.9%

Source: 2010 Carlsbad Municipal Urban Water Management Plan

Results

Table 3-4 shows the emissions from the SEEC community forecast for each sector—residential, commercial, industrial, transportation, solid waste, landfill, and wastewater—and the sum total community emissions. The forecast includes the reduction from RPS and Pavley I Fuel Economy Standards, which are quantified separately in Section 3.5, below. The forecast also includes the effect of the General Plan land use and circulation system on transportation emissions (compact, infill, mixed-use, and transit-oriented development, open space protection, new traffic signals and roadway extensions). The Carlsbad General Plan EIR quantifies the reduction in VMT due to the proposed General Plan in comparison to higher VMT under the existing General Plan (the No Project alternative).

The greatest projected emissions continue to be from the transportation sector, which accounts for 41 percent of emissions in 2020 and 36 percent of emissions in 2035. Residential emissions are the next largest sector, with 26 percent of emissions in 2020 and 28 percent of the total in 2035. Commercial, industrial, and solid waste, wastewater, and landfill emissions are the next largest sectors in order of total emissions.

TABLE 3-4: COMMUNITY FORECAST EMISSIONS BY SECTOR, 2011, 2020, AND 2035 ($MTCO_2E$)

Sector	2011	2020	2035
Residential	176,405	145,419	163,881
Commercial	178,712	126,431	148,978
Industrial	46,248	31,278	35,249
Transportation	273,745	234,113	210,568
Solid Waste	21,719	23,073	26,002
Landfill	2,598	1,204	558
Wastewater	6,317	4,355	4,601
TOTAL	**705,744**	**565,873**	**589,837**

Figure 3-3: Comparison of Emissions by Sector in 2011, 2020 and 2035

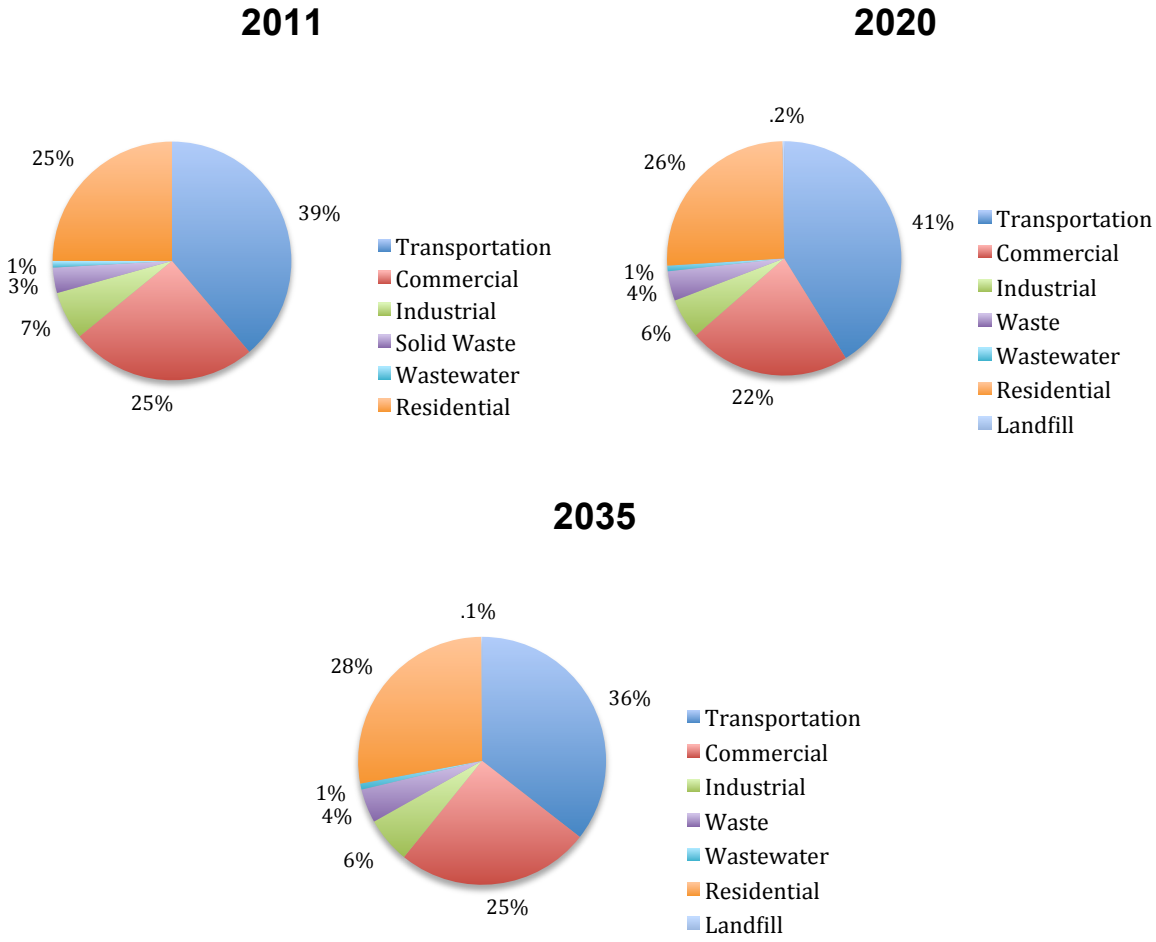
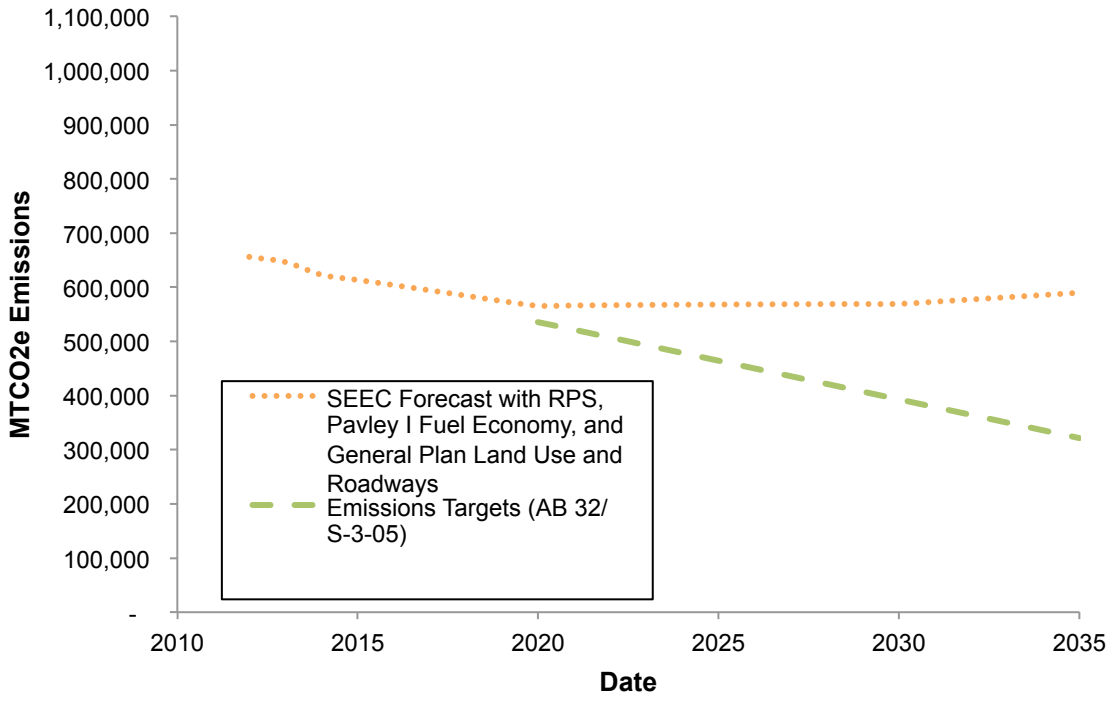


Figure 3-4 shows the change in SEEC-modeled community forecast emissions over time. Total emissions are projected to decrease from 705,744 $MTCO_2e$ in 2011 to 565,873 $MTCO_2e$ in 2020 (a decrease of 20 percent). The initial drop in emissions is mostly caused by the implementation of the RPS, which causes a decrease in residential, commercial, and industrial emissions, and Pavley I Fuel Economy Standards, which decrease transportation emissions. Over time, the decreases in emissions from an increased amount of renewable power usage and fuel efficiency improvements are canceled out by population growth, which cause emissions to increase from 2020 values to 589,873 $MTCO_2e$ in 2035 (an increase of 4 percent).

In 2020, the total emissions of 565,873 are about 30,000 $MTCO_2e$ above the AB 32 target emissions. The following section quantifies GHG reductions from State and Federal actions and applies them to the emissions forecast.

Figure 3-4: Community Forecast with RPS, Pavley I Fuel Economy Standards, and General Plan Land Use and Roadways



3.4 Government Operations Forecast

Methodology

The SEEC government operations forecast, which is a subset of the community forecast, covers direct emissions from the sources the City of Carlsbad owns and/or controls. The emissions from government operations are included in the totals shown in Table 3-4 and Figure 3-4 above. This section separates out emissions from government operations for accounting purposes. The government operations forecast includes mobile combustion of fuel for city vehicles and the use of natural gas to heat city buildings. Indirect emissions associated with the consumption of electricity, steam, heating, or cooling for city operations that are purchased from an outside utility are also forecast. All other indirect emissions sources, including employee commute and the decomposition of government-generated solid waste, are not included as part of the local government forecast, but rather are counted in the community forecast. The government operations inventory covers emissions from the following sectors:

- Buildings and Facilities
- Vehicle Fleet

- Public Lighting
- Water Delivery Facilities
- Wastewater Transport

The government operations forecast uses 2005 inventory to represent baseline emissions, and the 2011 inventory to provide an intermediate value to adjust the model.

Within each sector, certain types of emissions are assumed to scale with population growth, projected to grow at 0.9 percent annually through 2035, while other types of emissions are expected to remain constant or decrease with efficiency improvements. The following sections describe the assumptions underlying the forecast growth rates for each government operations sector.

Buildings and Facilities

The 2005 and 2011 inventories of emissions from all buildings and facilities operated by the city were used to determine the future growth for this sector. The natural gas and electricity demands were assumed to scale with population for departments such as Police, Fire, and Parks and Recreation, while others, such as Administration and Utilities, would remain staffed at current levels. These growth rates were then combined to determine an aggregate annual growth rate of 0.7 percent, which was applied to the buildings and facilities sector.

Vehicle Fleet

An estimate of the growth in the number of City employees was used to determine City fleet use. The growth in fleet emissions beyond 2011 was estimated by assuming—similar to the Buildings and Facilities sector—that certain departments would scale with population growth, while others would remain staffed at current levels. These growth rates were then combined to determine an aggregate annual growth rate of 0.6 percent, which was applied to the city fleet sector.

Public Lighting

From 2005 to 2011, electricity use for streetlights decreased approximately 4 percent due to the installation of some energy-saving induction streetlights. Following the completion of the installation of all induction streetlights, the City's electricity demand for streetlights was further reduced, which is reflected in the forecast energy demands for this sector.

Water Delivery and Wastewater

The increased demand for energy usage for water delivery and wastewater was assumed to be proportional to the amount of water delivered by the Carlsbad Municipal Water District (CMWD), as projected in the 2010 Urban Water Management Plan (UWMP). CMWD's service area covers about 85 percent of the City, and it was assumed that water and wastewater usage in the remaining 15 percent of the City, served by Olivenhain Municipal Water District and Vallecitos Water District, would follow similar water use patterns as outlined in the 2010 UWMP.

Results

The city operations forecast for 2020 and 2035 is shown by sector in Table 3-5. Government operations emissions are projected to decrease from the 2011 inventory total of 8,205 $MTCO_2e$ to 5,185 $MTCO_2e$ in 2020. The decrease in emissions is primarily due to the implementation of the RPS and the fuel efficiency gains from Pavley I standards. Emissions are forecast to then increase at a low rate through the year 2035 to 5,922 $MTCO_2e$, due to projected increases in city staff in select departments to accommodate an increased need for city services.

The relative contribution of each sector to the total city operations emissions is generally constant over time. The two largest emissions sectors are buildings and facilities, comprising about 40 percent of total emissions, and fleet emissions, which are approximately 33 percent of the total emissions. Streetlights are about 15 percent of total emissions, followed by wastewater facilities at 8 percent, and water delivery facilities at 1 percent. Overall, government operations emissions are forecast to remain a small portion of community emissions, about 0.9 percent in 2020 and 1 percent in 2035. Chapter 4 discusses mitigation measures that will reduce government operations emissions.

TABLE 3-5: GOVERNMENT OPERATIONS EMISSIONS INVENTORY (2011) AND 2020, 2035 FORECAST ($MTCO_2E$)

Sector	2011	2020	2035
Building & Facilities	3,410	2,192	2,409
Streetlights	1,747	902	902
Water Delivery Facilities	79	71	76
Wastewater Facilities	716	470	506
Fleet	2,253	2,092	2,029
TOTAL	**8,205**	**5,185**	**5,922**

3.5 GHG Reductions to Community Forecast from State and Federal Actions

Methodology

GHG reductions from state and federal actions and other trends to the community forecast are quantified in this section. These reductions include the following:

- Renewable Portfolio Standard
- Pavley I fuel economy standards
- Low Carbon Fuel Standard
- Title 24 building efficiency improvements

- Reductions in VMT from rising gasoline prices[18]

The GHG reductions from these factors were quantified using the EPIC mitigation calculator. The Energy Policy Initiatives Center (EPIC) at the University of San Diego developed this model to create business-as-usual projections, set targets, and calculate levels of mitigation measures for all local jurisdictions in the San Diego region. As the EPIC model was developed specifically for cities within San Diego County and the mitigation calculator calculates the effect of the federal and statewide reductions, it was selected to quantify these policies and actions. GHG reductions from the RPS and Pavley I fuel economy standards were accounted for in the SEEC model; however, they are quantified separately in this section for informational purposes.

Renewable Portfolio Standard (RPS)

California's RPS, established in 2002 by the California State Senate in Senate Bill 1078, accelerated in 2006 and expanded in 2011, is one of the most ambitious renewable energy standards in the country. The RPS requires that investor-owned utilities like SDG&E supply 33 percent of their electricity from renewable resources by 2020. While a renewable portfolio standard past 2020 has not been established, the assumption used in the EPIC mitigation calculator was that the 33 percent renewable standard would be extended through the year 2035—a conservative assumption, given that this is targeted to already be attained by 2020. Table 3-6 lists the reductions from the RPS in 2020 and 2035.

TABLE 3-6: RPS GHG REDUCTIONS

Year	$MTCO_2e$ Reductions
2020	48,962
2035	36,160

Pavley I Fuel Economy Standards

In 2009, CARB adopted amendments to the Pavley regulations to reduce GHG emissions in new passenger vehicles from 2009 to 2016. The standards set became the model for the updated Corporate Average Fuel Economy (CAFE) standards set by the US EPA. The emissions reductions from the improved fuel efficiency standards were calculated using the EPIC mitigation calculator, and were phased in following the 2011 inventory. Table 3-8 lists the emissions reductions from Pavley I fuel economy standards in 2020 and 2035. These reductions are already quantified and applied in the SEEC community forecast, and have been listed separately here for reference purposes.

[18] The rise in gasoline prices are not a result of any state or federal policy or action, but are included in this section as part of a larger systemic trend forecast to occur regardless of other emission reduction measures.

TABLE 3-8: PAVLEY I FUEL ECONOMY STANDARD GHG REDUCTIONS	
Year	**$MTCO_2e$ Reductions**
2020	40,354
2035	48,369

Low Carbon Fuel Standard

The Low Carbon Fuel Standard, adopted by CARB, is performance-based and is designed to reduce the GHG intensity of transportation fuels by 10 percent by 2020. The regulation established annual performance standards that fuel producers and importers must meet beginning in 2011. The Low Carbon Fuel Standard applies to all fuels used for transportation in California, including gasoline, diesel fuel, E85, compressed or liquefied natural gas, biogas, and electricity. The Standard is also "lifecycle" based, meaning the entire extraction, recovery, production and transportation of the fuel is taken into account. The default assumption of 10 percent reduction in GHG intensity was assumed to continue through 2035 for the EPIC mitigation calculator. Table 3-9 shows the reductions from the Low Carbon Fuel Standard in 2020 and 2035.

TABLE 3-9: LOW CARBON FUEL STANDARD GHG REDUCTIONS	
Year	**$MTCO_2e$ Reductions**
2020	20,545
2035	14,906

Title 24 Building Efficiency Improvements

Title 24 is California's Building Energy Code, which is updated every three years. In 2010, Title 24 was updated to include the California Green Building Standards Code, referred to as CALGreen. CALGreen requires that new buildings reduce water consumption, increase system efficiencies, divert construction waste from landfills, and install low pollutant-emitting finish materials. CALGreen has mandatory measures that apply to nonresidential and residential construction. The most recent CALGreen code became effective in 2014.

The Title 24 building efficiency improvements determine the effect of the CALGreen code mandatory measures for new building construction using the 2010 code update.[19] Table 3-10 lists the GHG reductions from building efficiency improvements in new construction calculated using the EPIC mitigation calculator in 2020 and 2035.

[19] The EPIC mitigation calculator is based on the 2010 CALGreen code. The 2014 CALGreen code and subsequent updates will likely result in greater GHG reductions as building efficiency standards improve.

TABLE 3-10: TITLE 24 BUILDING EFFICIENCY IMPROVEMENTS GHG REDUCTIONS	
Year	**$MTCO_2e$ Reductions**
2020	1,836
2035	3,582

Reduction in VMT from Rising Gasoline Prices

The U.S. Energy Information Administration (EIA) collects, analyzes and disseminates independent and impartial energy information, including projections of future gasoline prices. The 2013 EIA gasoline projection estimate a pump price of gasoline of $4.00 per gallon in 2020 and $6.00[20] in 2035 per gallon in California.

The EPIC mitigation calculator measures emissions reductions from changes in fuel consumption as a result of gasoline price increases. The reductions in GHG emissions based on the Energy Information Administration gasoline prices are shown in Table 3-11. Although the projected rise in gasoline prices is not the direct result of a federal or state policy, this effect was considered in this section, as it is a larger systemic trend that is forecast to occur regardless of other emissions reductions measures.

TABLE 3-11: GHG REDUCTIONS FROM RISING GASOLINE PRICES	
Year	**$MTCO_2e$ Reductions**
2020	12,201
2035	71,316

RESULTS

The annual reductions from the above state and federal actions—RPS, Pavley I Fuel Economy Standards, Low Carbon Fuel Standard, Title 24 building efficiency improvements, and the reductions in VMT from rising gasoline prices—were combined. Table 3-12 lists the total SEEC community forecast in 2020 and 2035, juxtaposed with reductions from state and federal actions not accounted for in the SEEC forecast: the Low Carbon Fuel Standard, Title 24 Building Standards, reductions in VMT from higher gasoline prices, and the assumed continuation of the Renewable Portfolio Standard after the year 2020. Figure 3-5 shows the SEEC Forecast with General Plan land use and new roadways, as well as state and federal actions.

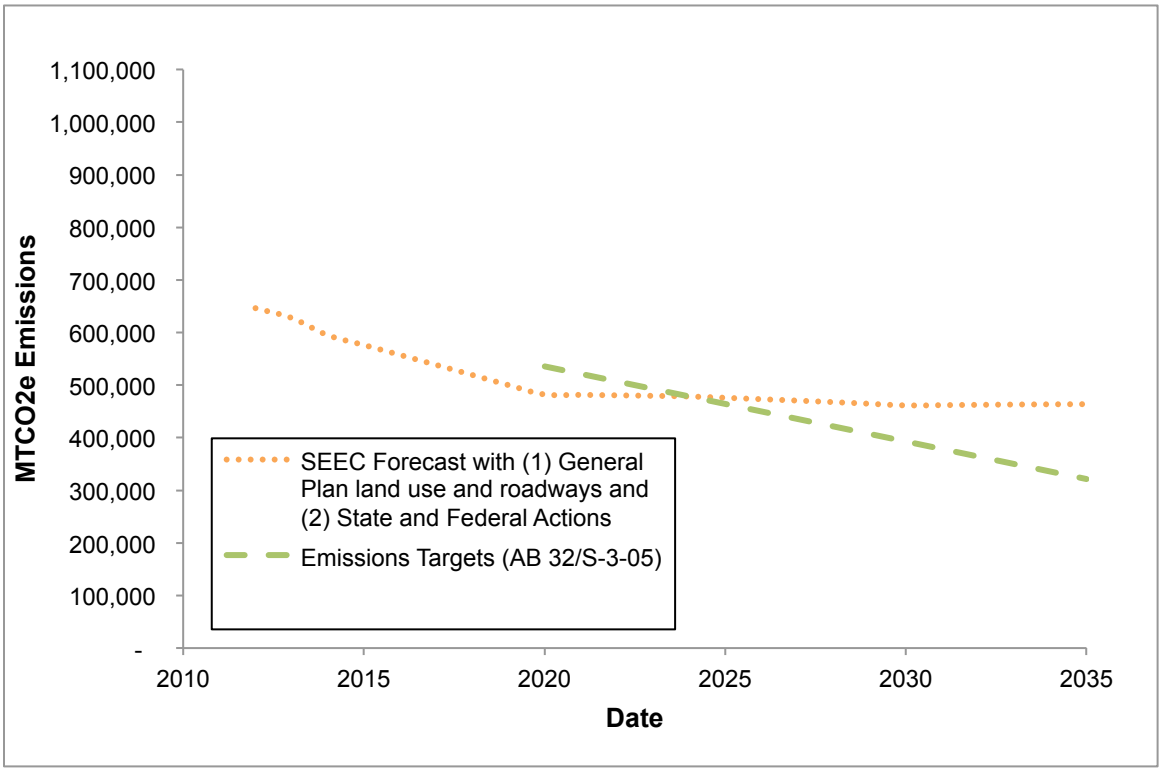
[20] Both values are listed in 2010 dollars.

TABLE 3-12: COMMUNITY FORECAST WITH STATE AND FEDERAL ACTIONS ($MTCO_2e$)

Year	Community Forecast Emissions with General Plan Land Use and New Roadways	Low Carbon Fuel Standard Reduction	Title 24 Building Efficiency Improvements	Reductions in VMT from Rising Gasoline Prices	Continuation of Renewable Portfolio Standard, 2020 to 2035*	Total Forecast Emissions with General Plan Land Use and New Roadways & State and Federal Actions
2020	565,873	20,545	1,836	12,201	48,962	482,329
2035	589,837	14,906	3,582	71,316	36,160	463,873

*RPS considered in SEEC forecast through 2020, RPS continuation through 2035 modeled in EPIC

Figure 3-5: Community Forecast with (1) General Plan Land Use and New Roadways and (2) State and Federal Actions ($MTCO_2e$)



3.6 Modified Baseline: GHG Reductions from Additional General Plan Policies and Actions

Methodology

This section describes General Plan policies and actions that reduce GHG emissions, quantifies emissions reductions, and explains how these policies and actions will be implemented. These reductions are from policies and actions in addition to Pavley I, the RPS, and the General Plan land use and circulation system, which incorporate reductions from "No Project" conditions which are already reflected in the SANDAG modeling discussed previously. The General Plan policies and actions are organized according to the following categories:

- Bikeway System Improvements
- Pedestrian Improvements and Increased Connectivity
- Traffic Calming
- Parking Facilities and Policies
- Transportation Improvements

The California Air Pollution Control Officers Association's (CAPCOA's) Quantifying Greenhouse Gas Mitigation Measures report was developed as a resource for local governments to assess emissions reductions from GHG mitigation measures. This section uses the methodology outlined in the CAPCOA report for each category to quantify emissions reductions from the General Plan policies and actions.[21] The reductions are applied to the community forecast in the following section to get the "modified baseline" forecast.

Bikeway System Improvements

Bikeway System Improvements	*General Plan Policies:* *2-P.22, 2-P.23, 2-P.43, 2-P.44, 2-P.51, 2-P.85; 3-P.6, 3-P.11, 3-P.12, 3-P.13, 3-P.16, 3-P.17, 3-P.18, 3-P.20, 3-P.21, 3-P.22, 3-P.23, 3-P.24, 3-P.25, 3-P.27, 3-P.28, 3-P.29, 3-P.30, 3-P.36; 4-P.39*	2020 Reduction: **164 MTCO$_2$e** 2035 Reduction: **147 MTCO$_2$e**

Policy/Action Description

The Carlsbad Bicycle Master Plan, referenced in the General Plan, recommends the enhancement of the existing bicycle network with the implementation of approximately 6.5 miles of new Class I bike paths, 2.8 miles of new Class II bike lanes, and 4.2 miles of new Class III bike routes. The planned bikeways include the Coastal Rail Trail, a Class I bike path on

[21] While many of the policies and actions quantified in the report are project-level in nature, much of the supporting literature is from studies on a citywide, countywide, or regional context. The methodology in this section is based on these regional studies, which is therefore applicable to the General Plan policies and actions listed in this section.

Carlsbad Boulevard at Ponto, two Class II bike lanes – one on Hillside Drive and another on Avenida Encinas, and five Class III bike route projects in the northwest quadrant of the city. Additionally, the Mobility Element identifies the following new connections to improve connectivity in the area:

- A new Class I trail at the terminus of Cannon Road and extending eastward toward the City of Oceanside
- A new Class I trail along the Marron Road alignment between El Camino Real and the City of Oceanside
- A new crossing of the railroad tracks at Chestnut Avenue.

In total, the recommended enhancements will create a total of 13.5 miles of new bike paths, to result in a total of 111.5 miles of bike paths.

Quantification

An estimated 0.05 percent reduction in transportation GHG emissions is assumed to occur for every 2 miles of bike lane per square mile in areas with density greater than 2,000 people per square mile.[22] Carlsbad currently has approximately 2,700 people per square mile, greater than the threshold of 2,000 people per square mile.

With the total bicycle improvements, there would be approximately 2.85 miles of bike lanes per square mile, which corresponds to a 0.07 percent reduction in VMT emissions, or about 164 $MTCO_2e$ in 2020, and 147 $MTCO_2e$[23] in 2035.

Implementation

The bikeway system enhancements will occur through the implementation of the Carlsbad Bicycle Master Plan and the General Plan.

Pedestrian Improvements and Increased Connectivity

Pedestrian Improvements and Increased Connectivity	*General Plan Policies:* *2-P.22, 2-P.23, 2-P.43, 2-P.44, 2-P.45, 2-P.46, 2-P.48, 2-P.51, 2-P.68, 2-P.75, 2-P.85; 3-P.6, 3-P.12, 3-P.13, 3-P.16, 3-P.17, 3-P.18, 3-P.20, 3-P.21, 3-P.22, 3-P.23, 3-P.24, 3-P.25, 3-P.27, 3-P.28, 3-P.29, 3-P.36; 4-P.39*	2020 Reduction: **2,341 $MTCO_2e$** 2035 Reduction: **2,106 $MTCO_2e$**

[22] Cambridge Systematics. Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions. Technical Appendices. Prepared for the Urban Land Institute.

[23] In this chapter, reductions based on a portion of VMT have lower reductions in 2035 than in 2020 because they are assumed to decrease with greater vehicle efficiency standards over time.

Policy/Action Description

Pedestrian Improvements

Carlsbad has adopted several programs and plans related to improving the walking environment. The city's Pedestrian Master Plan guides the future development and enhancement of pedestrian facilities to ensure that walking becomes an integral mode of transportation in Carlsbad. The Carlsbad Residential Traffic Management Program provides a mechanism for community members to report issues relating to speeding and traffic volumes on residential roadways, assisting the city in "calming" traffic in these areas to make them more comfortable for pedestrian travel.

Physical barriers to pedestrian access include gaps in sidewalks, high-volume, high-speed streets, a circuitous roadway system in several parts of the city, and regional infrastructure such as freeways and railways that presents barriers to pedestrian mobility. There are four significant concentrations of high pedestrian improvement needs across the City of Carlsbad, including the following locations:

- The entire northwest quadrant, especially the Carlsbad Village area
- The southern coastal area along Carlsbad Boulevard, between Cannon Road and La Costa Avenue
- Several locations along El Camino Real, near Camino Vida Roble, Aviara Parkway/Alga Road and La Costa Avenue
- The southeastern portion of the city, stemming from the intersection of La Costa Avenue and Rancho Santa Fe Road

A range of potential improvement projects exists throughout the city, as identified in the pedestrian master plan, to enhance pedestrian mobility, local connectivity, usage, safety and accessibility. These improvements include filling in gaps in sidewalk connectivity, upgrading substandard sidewalks, creating new connections to pedestrian attracting designations (such as access across the railroad track to the beach at Chestnut Avenue, for example), establishing safe routes to school, enhancing crosswalks, installing pedestrian countdown signals, improving signage, and providing ADA improvements.

Increased Connectivity

Increasing connectivity in the city is critical to achieving the Carlsbad Community Vision. There are a number of improvements described in the General Plan that will enhance connectivity for bicycles and pedestrians, as noted below:

- Cannon Road east of College Boulevard – Provide a bicycle/pedestrian facility that would begin at the current eastern terminus of Cannon Road and continue eastward to the city's eastern boundary.
- Marron Road Connection – Provide a bicycle/pedestrian facility that would begin at the current eastern terminus of Marron Road and extend eastward to the city's eastern boundary.

- Additional crossings of Interstate-5 and the railroad – Continue to look for opportunities to add crossings of these two barriers and improve east-west connectivity to and from the coast. Key connections will include a crossing at Chestnut Avenue (bicycle, pedestrian, and vehicular) under the freeway and (bicycle and pedestrian) across the railroad, and a Chinquapin Avenue connection (bicycle, pedestrian, and vehicular) over the freeway and (bicycle and pedestrian) across the railroad. Additionally, Caltrans is designing a number of new pedestrian and bicyclist connections along and across Interstate-5 and near the lagoons as part of the Interstate-5 North Coast Corridor Public Works Plan. The city will continue to coordinate with Caltrans on these improvements.
- Improved accessibility to the lagoons and to the coast are envisioned to improve connectivity to those areas.

Quantification

Providing an improved pedestrian network and increasing connectivity encourages people to walk more and results in people driving less, causing a reduction in VMT. An estimate of a 1 percent reduction in VMT from pedestrian improvements and connectivity was assumed[24], which corresponds to a reduction of 2,341 $MTCO_2e$ in 2020 and 2,106 $MTCO_2e$ in 2035.

Implementation

Pedestrian improvements and increased connectivity will occur through implementation of the Pedestrian Master Plan, the Residential Traffic Management Program, and the General Plan.

Traffic Calming

Traffic Calming	*General Plan Policies:* *2-P.51; 3-P.12, 3.P-13*	2020 Reduction: **585 $MTCO_2e$** 2035 Reduction: **526 $MTCO_2e$**

Policy/Action Description

The Carlsbad Residential Traffic Management Program provides a mechanism for community members to report issues relating to speeding and traffic volumes on residential roadways, assisting the City in "calming" traffic in these areas to make them more safe and comfortable for pedestrian travel. Traffic calming devices include speed tables, speed bumps, roundabouts, and other devices that encourage people to drive more slowly or to walk or bike instead of using a vehicle, especially for short trips in and around residential neighborhoods.

Quantification

CAPCOA's "Quantifying Greenhouse Mitigation Measures" was used to quantify the effect of traffic calming devices. A 0.25 percent reduction in VMT was assumed to occur from these

[24] Center for Clean Air Policy. Transportation Emission Guidebook. http://www.ccap.org/safe/guidebook/guide_complete.html.

improvements, which corresponds to a reduction of 585 $MTCO_2e$ in 2020 and 526 $MTCO_2e$ in 2035.

Implementation

The traffic calming improvements will occur through the implementation of the Residential Traffic Management Program and the General Plan.

Parking Facilities and Policies

Parking Facilities and Policies	*General Plan Policies:* *2-P.71, 2-P.79; 3-P.24, 3-P.34, 3-P.35, 3-P.36, 3-P.37*	2020 Reduction: **4,682 $MTCO_2e$** 2035 Reduction: **4,211 $MTCO_2e$**

Policy/Action Description

Getting parking right is critical to ensuring the success of any urban area. Inadequate parking is inconvenient and frustrating for businesses and residents. Too much parking underutilizes valuable land, results in lower density development, discourages use of other forms of transportation (such as public transit), spreads out land uses, and creates gaps in store fronts; thereby practically requiring the use of the automobile. Additionally, too much parking also requires more driveways for accessibility, introducing conflicts between pedestrians and vehicles. Overly high parking requirements—particularly in downtown areas or urban cores—can impact the ability to renovate or repurpose older buildings and revitalize activity centers that can be better served and connected by enhancing facilities and amenities for bicyclists and pedestrians. Therefore, it is important to "right size" and manage parking such that there is enough to support the needs generated by the use, but not so much that it wastes land and impairs other ways of getting around.

The city's Zoning Ordinance provides standards for parking facilities based on development types within the city. To promote "right sizing" of parking facilities, the following techniques are included as part of the General Plan Mobility Element:

- Shared Parking – continue to allow uses that have different parking demands at different times of the day to share the same parking facilities. This is an effective way to minimize pavement, allow denser land use, provide for more landscaping, and provide improved walkability within a mixed use area. The best example of shared parking is an office building and an apartment building as office's peak parking demand occurs at 10:00 a.m. and apartment's peak parking demand occurs at 11:00 p.m.
- Collective Parking – allow uses in mixed use projects/areas to utilize up to 50 percent of project site's vacant on-street parking to count toward their parking supply requirements.
- Unbundled Parking – rather than provide free guaranteed parking, "unbundle" the parking from the development and require residents and/or employees to pay for use of a parking space.

- Park Once – a strategy in destination districts to enable visitors to "park once" and visit a series of destinations. Park once strategies work well in areas like the Village and areas that are well connected by pedestrian and bicycle facilities. The creation of centralized parking areas supports this strategy.
- In Lieu Parking Fees – continue strategies in appropriate areas by which developers can contribute fees toward the development of a common parking facility in lieu of providing on-site parking. This works best in downtown or concentrated commercial areas, works well to assist in paying for unified structured parking, and provides developers an opportunity to increase density on their parcels.
- Parking Management Strategies –a business district or businesses manage high demand parking locations and destinations through a number of different strategies including demand pricing, time restrictions, valet parking, and other techniques.
- Public-Private Partnerships –the city, business owners, and developers collaborate to provide both private and public parking opportunities. Instances where this works well include parcels owned by the city, where a private entity comes in and develops, manages, and enforces the parking in these public lots.
- Parking Locater Signs – electronic monitoring devices that identify the available parking in a given facility and utilize changeable message signs to assist travelers in identifying available parking locations. Please note that this may require modifications to the city's zoning ordinance to be implemented in some areas of the city.
- Parking Wayfinding Signs – signs identifying where public parking is available, which support the "park once" concept.
- Reduced Parking Standards – reduce parking standards in areas that are well served by transit, provide shuttle accessibility to the COASTER station, provide parking cash out programs (where employers pay employees to not park on site), or provide other programs that will reduce parking demand.
- Biking Equals Business Program – businesses provide bicycle parking or corrals and provide incentives to encourage their patrons and employees to ride rather than drive.
- Transit Equals Business Program – businesses provide their customers and employees incentives to encourage them to use transit rather than drive.
- Bicycle Corrals in Lieu of Vehicle Parking – for certain businesses, reduce required onsite parking for vehicles if they provide a bicycle corral that accommodates more people.

Although there are additional parking strategies that are available and may become available in the future, most of the strategies work best in smart growth/mixed use development areas and will be necessary to accomplish the goals and visions identified in the General Plan and the General Plan Mobility Element.

Quantification

According to CAPCOA's Quantifying GHG Mitigation Measures, parking strategies have estimated VMT reductions. Reduced parking standards and other policies reducing parking

availability have an estimated 5 to 12.5 percent VMT reduction, unbundled parking cost has a 2.6 to 13 percent VMT reduction, and parking management strategies have a 2.8 to 5.5 percent VMT projection.[25] Conservatively assuming the combined effect of these parking reduction strategies would result in the lower end of the strategies results, and considering that the strategies would be most applicable in future growth and infill areas, the cumulative reduction from implementations would result in a 2 percent VMT reduction to give an estimated 4,682 $MTCO_2e$ reduction by 2020, and a 4,211 $MTCO_2e$ reduction by 2035.

Implementation

The parking strategies will occur through the implementation of the Zoning Ordinance and the General Plan.

Transportation Improvements

Transportation Improvements	*General Plan Policies:* *2-P.46, 2-P.68; 3-P.6, 3-P.15, 3-P.16, 3-P.23, 3-P.27, 3-P.28, 3-P.31, 3-P.32*	2020 Reduction: **1,475 $MTCO_2e$** 2035 Reduction: **1,327 $MTCO_2e$**

Policy/Action Description

Transit in Carlsbad includes bus service, ADA paratransit service, and the COASTER commuter rail; indirectly, transit service is also provided by the Sprinter light rail system, Amtrak rail service, and Metrolink commuter rail. Future transit service in the city will primarily be coordinated by the North County Transit District (NCTD). In addition, there are several planned transit improvements for Carlsbad that are part of San Diego Association of Governments (SANDAG) regional planning efforts. These are reflected in the General Plan Mobility Element:

- Coastal rail improvements are proposed for the tracks serving the COASTER and Surfliner trains in San Diego County along the Los Angeles to San Diego Rail Corridor. These proposed improvements include double tracking, bridge replacements, and station improvements. Improvements to the COASTER service (2020 and 2030) are also proposed and would increase service and reduce headways.
- Route 471 (2020) is a proposed rapid bus providing frequent service between Carlsbad and San Marcos via Palomar Airport Road. This route will operate with 10 minute headways during peak and off-peak hours. In the city, this rapid bus route is envisioned to be supported by signal priority at intersections.
- AMTRAK will add service to Carlsbad.
- As previously described, the above future transit improvements will continue to advance the backbone transit infrastructure. However, one key component to improving transit use is improving the "first mile/last mile" access and experience for transit users. This typically includes end of trip facilities (bike racks, showers, changing

[25] The maximum reduction provided from the combination of all parking policies in the CAPCOA report is a 20 percent reduction in VMT

rooms, etc.) and better connectivity from the transit stop to the ultimate destination via bicycle facilities, pedestrian facilities, local transit circulators, etc.

- Carlsbad's future transit effectiveness will depend on major employers assisting with providing some of these "first mile/last mile" facilities through transportation demand management (TDM) measures. TDM is envisioned to include shuttle circulators to major employers and destinations, showers and changing rooms at those locations, and a host of other typical TDM techniques that would support transit usage and the connection to the ultimate destination. This Mobility Element also supports TDM through potential incentives (such as reduced parking standards for TDM implementation) to further support transit access to these destinations.
- The final component to improving transit use in the city is working with NCTD to improve the transit experience, particularly along the bus routes. This includes improving bus stops in the city to ensure that they are well lit, have seating, and are covered to protect users from inclement weather.

The city has also implemented a state-of-the-practice traffic signal management (TSM) system. This system integrates traffic signals in the city to a single access point, allowing city staff to monitor and update signal timings to improve safety and mobility for all users in the city. The Mobility Element supports further implementation of this program and use of other technologies that become available, which have the ability to improve mobility for all users of the city's transportation system.

Quantification

Transportation system improvements can result in VMT reductions. According to CAPCOA's Quantifying Greenhouse Gas Mitigation Measures, transit system improvements can result in the following reductions: 0.02 to 3.2 percent VMT reduction from a bus rapid transit system, 0.1 to 8.2 percent VMT reduction from expanding the transit network, 0.02 to 2.5 percent VMT reduction from increasing transit service frequency and speed, and 0.5 to 24.6 percent VMT reduction from increasing transit accessibility. Reductions from TSM were estimated using Cambridge Systematics' Moving Cooler report as a 0.01 percent VMT reduction. Conservatively assuming the combined effect of these strategies, summing the low end of the VMT reduction ranges gives a 0.63 percent reduction in VMT emissions.

Implementation

Transit improvements will primarily be coordinated by NCTD and will also be implemented by SANDAG regional planning efforts.

Results

Table 3-13 shows the GHG reductions from each of the above General Plan policies and actions. The largest reduction comes from parking facilities and policies, followed by pedestrian improvement and increased connectivity, transportation improvements, traffic calming, and bikeway system improvements. VMT emissions are projected to fall in the future due to higher fuel efficiency standards; however, as the efficiency gains are expected to be largely achieved by 2020 but the VMT is projected to continue climbing in the future, the

effect of the VMT reductions are greater in 2020 than in 2035 for all General Plan policies and actions considered in this section. For example, the reductions from traffic calming in 2035 are 526 $MTCO_2e$, which is less than the reduction in 2020 of 585 $MTCO_2e$. The reductions from these policies and actions are incorporated into the community emissions forecast in the following section.

TABLE 3-13: GHG REDUCTIONS FROM ADDITIONAL GENERAL PLAN POLICIES AND ACTIONS

Year	Bikeway System Improvements	Pedestrian Improvements and Increased Connectivity	Traffic Calming	Parking Facilities and Policies	Transportation Improvements	Total GHG Reductions from Additional General Plan Policies and Actions
2020	164	2,341	585	4,682	1,475	9,247
2035	147	2,106	526	4,211	1,327	8,317

3.7 Modified Baseline and the GHG Emissions "Gap"

Table 3-14 shows the total community emissions with the reductions from the following policies and actions:

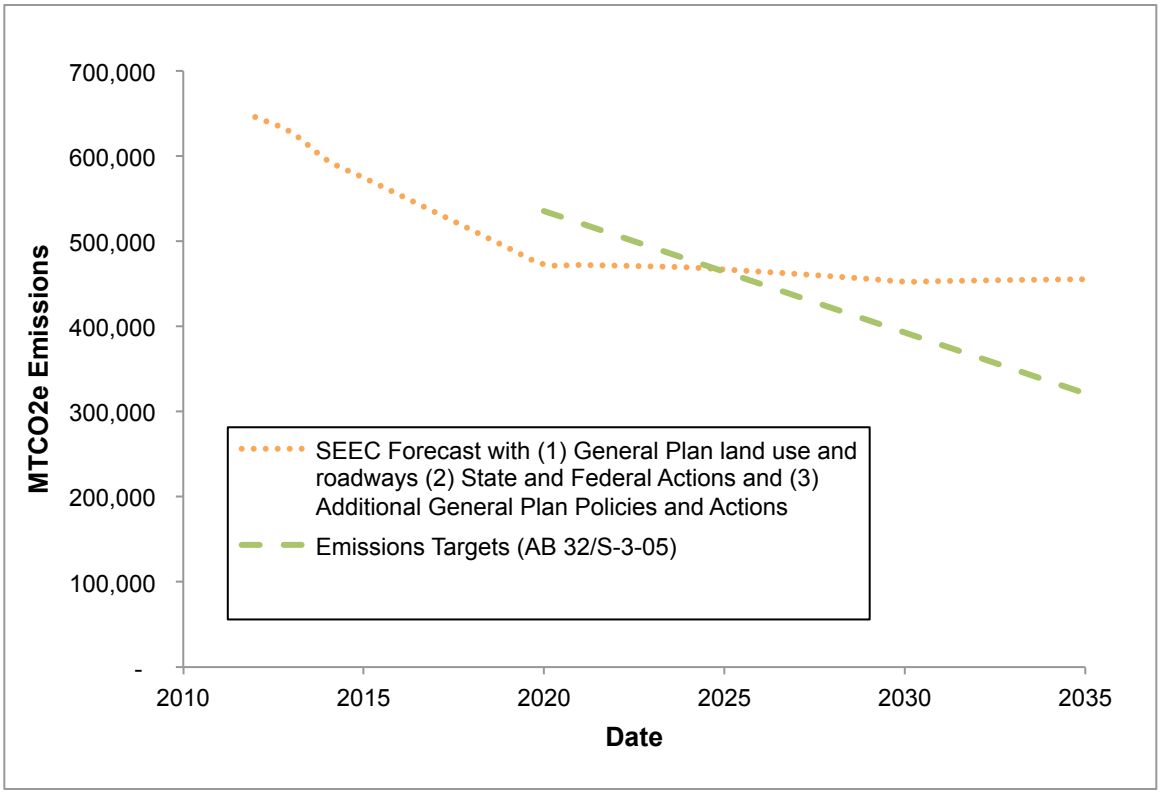
- General Plan land use and circulation system
- State and federal actions
- Additional General Plan policies and actions

Figure 3-6 shows the "modified baseline forecast," which incorporates the reductions discussed thus far in comparison to the emissions targets. Emissions drop steeply to 2020 from the combined effect of GHG reduction policies and actions, continue a gradual decline to 2030, but then start rising again after that, given that no increases in federal or state standards relating to fuel efficiency or renewable energy are assumed, even though these may well occur by that time. With the effect of all the GHG reductions considered in this chapter, the total community forecast emissions are 473,082 $MTCO_2e$ in 2020, and 455,556 $MTCO_2e$ in 2035. Table 3-14 shows that Carlsbad will meet its target for 2020 without any additional measures. However, by 2035, there is a GHG emissions "gap" of 134,098 $MTCO_2e$ — approximately one-third of the total projected community emissions.

TABLE 3-14: MODIFIED BASELINE FORECAST (FORECAST COMMUNITY EMISSIONS WITH GENERAL PLAN LAND USE AND ROADWAYS, STATE AND FEDERAL ACTIONS, AND ADDITIONAL GENERAL PLAN POLICIES AND ACTIONS)

Year	Total Modified Baseline Forecast ($MTCO_2e$)	GHG Emissions Targets (Linear Scaling of AB 32/S-3-05) ($MTCO_2e$)	Emissions "Gap" ($MTCO_2e$)
2020	473,082	535,763	Target Met
2035	455,556	321,458	134,098

Figure 3-6: Modified Baseline Forecast (Forecast Community Emissions with General Plan Land Use and Roadways, State and Federal Actions, and Additional General Plan Policies and Actions)



Conclusion

The emissions targets are met in the year 2020, with forecast emissions of 473,082 $MTCO_2e$ meeting the target by about 63,000 $MTCO_2e$. There is an emissions "gap" in the year 2035 of about 134,000 $MTCO_2e$ between the forecast emissions of 455,556 $MTCO_2e$ and the emissions target of 321,458 $MTCO_2e$. Chapter 4 contains CAP GHG reduction measures to close the gap between forecast emissions and emissions targets in the year 2035.

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4

CAP GHG Reduction Measures

The forecast emissions in Chapter 3 incorporate reductions from (1) state and federal actions, (2) General Plan land use and roadways, and (3) additional General Plan policies and actions. This chapter describes additional GHG reduction measures to close the emissions "gap" between emissions targets and forecast emissions for 2035. These are:

- Residential, commercial and industrial photovoltaic systems
- Building cogeneration
- Single-family, multi-family and commercial efficiency retrofits
- Commercial commissioning
- CALGreen building code
- Solar water heater/heat pump installation
- Efficient lighting standards
- Increased zero-emissions vehicle travel
- Transportation Demand Management (TDM)
- Citywide renewable projects
- Water delivery and conservation

The sections below describe the GHG reduction measures and explain how they will be implemented. The GHG reductions from these measures were quantified using the Energy Policy Initiatives Center (EPIC) mitigation calculator, a tool developed by the University of San Diego for cities within San Diego County. The EPIC mitigation calculator includes a "business as usual" (BAU) forecast for each measure estimating GHG reductions from trends already underway that will occur without any additional city intervention, based on regional San Diego Gas & Electric (SDG&E) forecasts. For example, under the BAU forecast for residential photovoltaic (PV) systems, the EPIC mitigation calculator estimates that by the year 2035, energy produced by residential PV systems in the City of Carlsbad will be about 15.9 megawatts (MW), which will offset about 6,233 metric tons CO_2e ($MTCO_2e$).

The GHG reduction measures describe goals, amount of reduction in 2035, and actions to meet the target levels. The actions are categorized as short-term (one to two years), mid-term (two to five years), or long-term (longer than five years), based on when they will be implemented following adoption of the CAP. The mixture of short-term, mid-term, and long-term actions presented for each measure are intended to meet the goals in a realistic timeframe and provide an effective combination to reach the targets set forth. The "already-projected" amount is based on the forecast BAU emissions reduction, followed by a target level to reach the goal of the measure. The measures are then described in greater detail, as is the method of quantifying the GHG emissions reduction, and the responsibility and implementation of the measure is discussed. Each measure qualitatively describes costs and benefits, both to the city and the private sector. Overall benefits of GHG emissions reductions include decreased costs through energy efficiency, reduced risk to human health and welfare, and less global climate change.

4.1 Residential, Commercial and Industrial Photovoltaic Systems

Measure A: Promote Installation of Residential Photovoltaic Systems	
Goal: Promote installation of residential PV systems to produce an additional 9.1 MW per year above already projected amounts, or the equivalent of 2,682 more homes with PV systems, by 2035.	2035 Reduction: 10,136 $MTCO_2e$
Actions: *A-1: Temporarily—for a period of one year—suspend residential and commercial PV system permit fees, together with a publicity campaign to promote PV systems installation* (Short-term) *A-2: On a continuing basis, ensure that regulatory provisions - such as complying with regulations for zoning, structure height, permit submittal and review, etc. - do not hinder residential and commercial PV system installation.* (Short-term) *A-3: Evaluate the feasibility of adopting an ordinance, similar to those passed by Lancaster and Sebastopol, which requires all new homes install PV panels to offset a portion of their energy use.* (Mid-term)	

Already-Projected Amount: Solar photovoltaic (PV) systems convert solar energy into electricity. The projected power generation[26] of residential PV systems at 4,685 homes is 15.9 MW[27] in the year 2035, which is enough to fully power these homes.[28]

[26] The maximum amount of power produced is also referred to as solar capacity.

[27] Solar capacity (MW) was converted into an annual energy total (kWh per year) as follows: The standard assumption is about 5 hours of production per day per solar system. The capacity was multiplied by 5 hours per day times 365 days per year to get a total production in kWh per year. Therefore, 15.9 MW converts to 29,017,500 kWh per year.

[28] Average household energy use was calculated as follows: The California per capita electricity use in 2010 was 2,337 kWh (source: http://www.eia.gov/state/?sid=CA). The average household size in 2010 was 2,65 people per household

Target: The target is 25 MW in the year 2035, which is the equivalent amount of production to power 7,367 homes.[29]

GHG Reduction Measure Description: PV systems convert solar energy into electricity. Producing renewable energy locally through residential, commercial, and industrial PV systems reduces the need to construct costly new power plants that produce air pollution, use natural resources, and impact the environment.

The San Diego region has among the highest rates of solar energy production in the nation, producing an annual average of about 6.5 kWh per square meter per day, according to the National Renewable Energy Laboratories. A 2006 estimate[30] found that existing PV technology could supply over 100 percent of the peak electricity demands for San Diego County, and over half of the total energy load. Measure A is to promote the installation of PV systems on single-family and multi-family homes above the already-projected amount (4,685 homes) by an additional 2,682 homes, or a total of about 15 percent of homes.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure A.

Responsibility and Implementation: The City of Carlsbad currently participates in three Property Assessed Clean Energy (PACE) programs: CaliforniaFIRST, FigTREE, and California HERO. PACE programs provide financing to eligible property owners for sustainable energy projects, thereby offering a source of funding for residential PV systems. Property owners can finance PV system installations and energy efficiency improvements through a voluntary assessment on their property tax bills. Several other financing options are available to residents, including Federal Housing Financing Administration- (FHFA) insured Energy Efficient Mortgages, HUD Title 1 Home Improvements Loans, and FHA PowerSaver Loans.

The city will temporarily suspend residential and commercial solar PV system permit fees. The city will also on a continuing basis ensure that regulatory provisions—such as complying with regulations for zoning, structure height, permit submittal and review process, etc.—do not hinder PV panel installation.

Costs and Benefits:

Private: Private costs would come from the installation and maintenance of a residential PV system, which can be supported by PACE programs and other incentives. Benefits would accrue from reduced energy bills and increased property values.

(source: http://www.census.gov/newsroom/releases/archives/2010_census/cb11-cn137.html). Therefore, the average household energy use in 2010 was: 6,193.1 kWh per year.

[29] It was assumed that residential PV systems produce the equivalent amount of energy to the amount consumed in each household on an annual basis.

[30] Anders, Scott and Bialek, Tom. 2006. Technical Potential for Rooftop Photovoltaics in the San Diego Region. Available: http://www.sandiego.edu/documents/epic/060309_ASESPVPotentialPaperFINAL_000.pdf.

City: City costs would occur from the analysis of potential regulatory barriers and the evaluating the feasibility of requiring new homes to install PV systems. Revenue would be lost when permit fees are temporarily suspended.

Measure B: Promote Installation of Commercial and Industrial Photovoltaic Systems	
Goal: Promote installation of commercial and industrial PV systems to produce an additional 10.7 MW per year above projected amounts, or roughly 15 percent of projected commercial and industrial electricity use, by 2035.	2035 Reduction: 13,336 $MTCO_2e$
Actions: (*See also actions A1 and A2 above)*. *B-1: Adopt a commercial energy conservation ordinance requiring all new nonresidential developments with more than 50 cars surface parked or on roofs of parking structures to use PV panels over at least half of the surface/roof-parked cars, or provide equivalent energy conservation/generation by other means (over and above other requirements).* (Mid-term) *B-2: Evaluate the feasibility of adopting an ordinance requiring existing nonresidential developments to install PV panels to offset a portion of their energy use.* (Mid-term)	

Already-Projected Amount: The projected power generation from commercial and industrial PV systems is 22.3 MW in the year 2035, which is about 30 percent of projected commercial and industrial electricity use.

Target: The target is the PV production of 33 MW in the year 2035, which is the equivalent amount of power production to supply about 45 percent of projected commercial and industrial demand.

GHG Reduction Measure Description: Photovoltaic (PV) systems convert solar energy into electricity. Measure B promotes the installation of PV systems on commercial buildings and industrial facilities above the already-projected amount of 22.3 MW, by an additional 10.7 MW. Together with the already-projected amount of power generation, Measure B would reach the target PV production of 33 MW in 2035.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure B.

Responsibility and Implementation: See Measure A (above) for implementation.

Costs and Benefits:

Private: Private costs would result from the installation and maintenance of commercial and industrial PV systems. Benefits would accrue from reduced energy bills and increased property values.

City: City costs would occur from removing potential regulatory barriers and preparing and enforcing a nonresidential PV systems ordinance. Revenue would be lost when permit fees are temporarily suspended.

4.2 Building Cogeneration

Measure C: Promote Building Cogeneration for Large Commercial and Industrial Facilities	
Goal: Promote building cogeneration for large commercial and industrial facilities, with the goal of producing 6.9 MW.	2035 Reduction: 1,067 $MTCO_2e$
Actions: *C-1: Promote cogeneration by publicizing grant opportunities and financial incentives, such as the Self-Generation Incentive Program and feed in tariffs for cogeneration systems, for renovations of existing buildings by posting these on the city's website and by other means.* (Short-term) *C-2: Install cogeneration systems on large city facilities that can benefit from the installation of these systems, and apply for funding through the Energy Efficiency Financing for Public Sector Projects program, or other similar funding sources.* (Mid-term) *C-3: Require cogeneration systems for large commercial and industrial facilities that have on-site electricity production, both for new construction and retrofits.* (Mid-term)	

Already-Projected Amount: The forecast capacity of building cogeneration systems is 6.9 MW in the year 2035.

Target: The target is to reach the already-projected amount.

GHG Reduction Measure Description: Building cogeneration, also known as combined heat and power (CHP), is the use of building power stations to simultaneously generate electricity and heat. Instead of purchasing electricity from a utility and burning fuel in an on-site furnace to produce needed heat, an industrial or commercial user can use building cogeneration to provide both electricity and heat in one energy-efficient step. Examples of facilities able to use building cogeneration include manufacturing plants, hospitals, water and wastewater treatment facilities[31], and large office buildings.

Building cogeneration reduces building energy costs, provides stability in the face of uncertain electricity prices, and enhances energy reliability. Building cogeneration also provides the opportunity to improve critical infrastructure resiliency, by allowing critical facilities to run without any interruption in service if the electrical grid is impaired. Measure C is to promote the installation of building cogeneration systems on large commercial and industrial facilities to reach the projected capacity of 6.9 MW by 2035.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure C.

Responsibility and Implementation: The City of Carlsbad will apply for funding to install cogeneration systems on city facilities that would benefit from the use of these systems. The city will also publicize incentives for the construction of cogeneration systems, and require

[31] The Encina wastewater treatment plant operates a cogeneration plant that produces over 60 percent of the electricity used by the facility.

cogeneration systems for new construction and retrofits of large commercial and industrial facilities through the permitting process, where the facility has on-site non-renewable electricity generation.

A number of funding sources exist to provide financial support for the installation of cogeneration systems. Funding for cogeneration systems for city facilities is available through the Energy Efficiency Financing for Public Sector Projects program. In addition to city government buildings, the program also applies to schools and other public or institutional facilities. There is no minimum loan amount, but the maximum loan amount per application is $3 million. The interest rate is 1 percent, and loans must be repaid from energy cost savings within 15 years, including principal and interest.

The Self-Generation Incentive Program (SGIP) provides financial incentives for the installation of new qualifying technologies, including cogeneration, that are installed to meet all or a portion of the electric energy needs of a facility.[32] SGIP is funded by the California Public Utilities Commission, and administered by the California Center for Sustainable Energy in SDG&E's service area. San Diego's 2014 share is approximately $10 million per year. Under the SGIP program, cogeneration systems receive an incentive of $1.83 per watt produced. SDG&E also offers seminars on the benefits of cogeneration and fuel cell options for large facilities.

For cogeneration systems that produce electricity in excess of the facility's needs, the state of California has initiated a feed-in tariff, which provides a cost-based price for renewable energy produced.

Costs and Benefits:

Private: Private costs would come from the installation and maintenance of building cogeneration systems, and which could be reduced through funding programs, such as SGIP. Benefits would accrue from reduced energy bills and increased property values.

City: City costs would come from promoting cogeneration systems, and incorporating the consideration of cogeneration into the permitting process for commercial and industrial facilities. Benefits could accrue from reduced energy bills for city facilities that utilize cogeneration systems.

[32] See the 2014 Self-Generation Incentive Program Handbook. Available: https://www.selfgenca.com/documents/handbook/2014

4.3 Single-family, Multi-family, Commercial, and City Facility Efficiency Retrofits

Measure D: Encourage Single-Family Residential Energy Efficiency Retrofits	
Goal: Encourage single-family residential efficiency retrofits with the goal of a 50 percent energy reduction compared to baseline in 30 percent of the total single-family homes citywide by 2035 (approximately 5,000 single-family homes out of a total of 17,000).	2035 Reduction: 1,132 $MTCO_2e$
Actions: *D-1: Publicize available incentive and rebate programs, such as SDG&E's Residential Energy Efficiency Program, on the city's website and by other means.* (Short-term) *D-2: Create a citywide "Energy Challenge," similar to the Department of Energy's Better Buildings Challenge, to promote cost-effective energy improvements, while having residents and building owners commit to reducing energy consumption.* (Short-term) *D-3: Adopt a residential energy conservation ordinance, which requires residential property owners to conduct and disclose an energy audit at the time of renovations over $50,000, to ensure that homes and residential developments meet specified low cost energy efficiency measures—such as requisite ceiling insulation, insulated pipes, water heater blankets and exterior door weather stripping.* (Mid-term)	

Already-Projected Amount: There is no projection for retrofits that would occur without this measure.

Target: The target is a 50 percent energy reduction in 30 percent of single-family homes citywide by the year 2035.

GHG Reduction Measure Description: As single-family homes use a large portion of the city's total energy and older homes are substantially less efficient than newly constructed homes, there is a large opportunity to reduce GHG emissions through the retrofitting of existing homes. When a single-family homeowner seeks to make improvements over $50,000 in valuation, the owner would be required to conduct an energy audit, and meet low-cost energy efficiency measures—such as improving insulation, providing weather stripping, promoting natural lighting and ventilation, and using "smart" thermostats to regulate energy use for heating and cooling.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure D.

Responsibility and Implementation: Homeowners would implement this measure. SDG&E offers a Residential Energy Efficiency Program, which offers residential customers rebates to improve the efficiency of appliances, such as water heaters, washers, refrigerators, air conditioners, building insulating, and ceiling fans. The City will publicize this and related programs on its website and by other means.

Costs and Benefits:

Private: Private costs would come from homeowners conducting energy audits and implementing efficiency retrofits. The cost of these retrofits is frequently 1 percent or less of the total renovation cost. Benefits would occur through reduced energy costs. Rebates are available as described above.

City: City costs would come from promoting incentive programs, creating an "Energy Challenge" program, and adopting and enforcing a residential energy conservation ordinance.

Measure E: Encourage Multi-Family Residential Efficiency Retrofits	
Goal: Encourage multi-family residential efficiency retrofits with the goal of a 50 percent energy reduction in 30 percent of the projected amount of multi-family homes citywide by 2035 (approximately 10,000 out of a total of 35,000).	2035 Reduction: 351 $MTCO_2e$
Actions: *See Measure D (above)*.	

Already-Projected Amount: There is no projection for retrofits that would occur without this measure.

Target: The goal is a fifty percent energy reduction in thirty percent of the projected amount of multi-family homes citywide by the year 2035.

GHG Reduction Measure Description: Multi-family residential retrofits provide an opportunity to reduce building energy use. Multi-family residential retrofits are similar to the single-family retrofits described in Measure D, but can provide increased energy savings; for example, increasing insulation between residential units benefits both units. Other examples of multi-family residential retrofits include replacing incandescent and halogen lamps with LED or CFL lamps, installing energy-efficient windows and efficient appliances, and using "smart" thermostats to regulate energy use for heating and cooling.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure E.

Responsibility and Implementation: Multi-family residential unit owners would implement this measure. SDG&E offers a Residential Energy Efficiency Program, which offers residential customers rebates to improve the efficiency of appliances, such as water heaters, washers, refrigerators, air conditioners, building insulating, and ceiling fans. The City will publicize this and related programs on its website and by other means.

Costs and Benefits:

Private: Private costs would come from multi-family residential unit owners conducting energy audits and implementing efficiency retrofits. Benefits would occur through reduced energy costs. Rebates are available as described above.

City: City costs would come from promoting incentive programs, and creating an "Energy Challenge" program.

Measure F: Encourage Commercial and City Facility Efficiency Retrofits	
Goal: Encourage commercial and city facility efficiency retrofits with the goal of a 40 percent energy reduction in 30 percent of commercial square footage citywide and in city facilities by 2035.	2035 Reduction: 18,377 $MTCO_2e$
Actions: *F-1: Undertake a program of energy efficiency retrofits for city-owned buildings, with the goal of 40 percent reduction in energy use, beginning with retrofits that would result in the most substantial energy savings.* (Short-term) *F-2: Promote available incentive and rebate programs, such as SDG&E's Energy Efficiency Business Rebates and Incentives Program, on the city's website and by other means.* (Short-term) *F-3: Adopt a commercial energy conservation ordinance, which requires property owners to ensure that commercial buildings meet specified energy efficiency measures—such as requisite heating, ventilation, and air conditioning improvements, service water system requirements, and improved refrigeration equipment, at the time of conducting renovations over $50,000 in valuation.* (Mid-term)	

Already-Projected Amount: There is no projection for retrofits that would occur without this measure.

Target: The target is a forty percent energy reduction in thirty percent of the projected amount of commercial square footage and in city facilities.

GHG Reduction Measure Description: Relatively straightforward fixes to commercial and city-owned buildings can significantly reduce spending on fuel and electricity for commercial buildings. Examples of retrofits include installing efficient boilers and equipment, installation of high-quality windows, efficient lighting, and other building energy improvements.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure F.

Responsibility and Implementation: Building owners would implement this measure for commercial buildings.[33] Funding is available through incentive and rebate programs, such as SDG&E's Energy Efficiency Business Rebates and Incentives Program. SANDAG is preparing an Energy Roadmap for the city, which will identify energy conservation measures the city

[33] AB 1103, the California Nonresidential Building Energy Use Disclosure Program, requires an owner of a nonresidential building to benchmark the building's energy use data and disclose the energy use prior to the sale of the building, or the lease and financing of the entire building. This benchmark data can be used to guide implementation of efficiency measures for buildings renovated after a recent sale.

can use to reduce energy use in city municipal operations.[34] Funding for city retrofits can be provided through the Energy Efficiency Financing for Public Sector Projects program, described above in Measure C.

Costs and Benefits:

Private: Private costs would come from building owners and business owners implementing efficiency retrofits. Benefits would occur through reduced energy costs. Costs could be offset through incentive and rebate programs.

City: City costs would come from retrofitting city facilities, providing resources to help guide building owners to implement this measure, promoting available incentive and rebate programs, and adopting and enforcing a commercial energy conservation ordinance.

4.4 Commercial and City Facility Commissioning

Measure G: Promote Commercial and City Facility Commissioning	
Goal: Encourage commercial and city facility commissioning, or improving existing and new building operations, with the goal of a 40 percent energy reduction in 30 percent of commercial square footage citywide and in city-owned buildings by 2035.	2035 Reduction: 18,377 $MTCO_2e$
Actions: *G-1: Promote commissioning programs on the city's website such as San Diego RCx, and similar programs for commercial buildings.* (Short-term) *G-2: Commission city facilities to improve building operations and reduce energy costs, with a goal of 40 percent energy reduction in 30 percent of city facility square footage. (Mid-term)*	

Already-Projected Amount: There is no projection for commercial commissioning that would occur without this measure.

Target: The target is a 40 percent energy reduction in 30 percent of existing and new commercial square footage citywide and in city facilities.

GHG Reduction Measure Description: Commercial commissioning is a systematic process of ensuring that a building performs according to its design and the occupant's operational needs. Commissioning allows the design developed to be successfully constructed and operated. Examples includes measuring temperatures and flow rates from heating, ventilation, and air conditioning (HVAC) systems to calibrate to a known standard, as well as reviewing operations to verify that controls are properly functioning.

[34] SANDAG. 2014. "Energy Roadmap for Local Governments." Available: http://www.sandag.org/index.asp?classid=17&projectid=373&fuseaction=projects.detail. Accessed: February 25, 2014.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure G.

Responsibility and Implementation: The City is responsible for commissioning city facilities. Building owners would implement this measure for commercial buildings. Programs exist to offer assistance with the commissioning. San Diego RCx, a SDG&E program, provides a free engineering study to qualified buildings to identify opportunities to save energy. After opportunities are identified, the program offers financial assistance to help pay the cost of implementing measures, which are typically low or no cost. Once implementation is complete, energy savings are confirmed with the utility, and the program pays the building owner the cost of the improvements.

Costs and Benefits:

Private: Private costs would come from building owners paying for building commissioning, which may be offset entirely through commissioning programs. Benefits would occur through reduced energy costs.

City: City costs would come from commissioning city facilities and from promoting commissioning programs to help guide building owners to implement this measure. Benefits would occur through reduced energy costs.

4.5 Green Building Code

Measure H: Implement Green Building Measures	
Goal: Implementation of a 5 percent improvement in energy efficiency above the City of Carlsbad residential green building code (based on CALGreen, the statewide green building code), for new construction.	2035 Reduction: 179 $MTCO_2e$
Action: *H-1: Adopt residential and commercial energy conservation ordinances requiring a 5 percent improvement in energy efficiency for residential and nonresidential new construction, above the existing City of Carlsbad green building code.* (Short-term)	

Already-Projected Amount: There are no projections for this measure.

Target: The target is a five percent improvement in energy efficiency above the mandatory requirements set in CALGreen.

GHG Reduction Measure Description: CALGreen, also known as Title 24, is California's Building Energy Code. CALGreen requires that new buildings reduce water consumption, increase system efficiencies, divert construction waste from landfills, and install low pollutant-emitting finish materials. CALGreen has mandatory measures that apply to nonresidential and residential construction. The most recent CALGreen code was adopted in

2013 and became effective in 2014. This measure applies a five percent improvement in energy efficiency above CALGreen as part of a local Green Building Code.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure H.

Responsibility and Implementation: The City of Carlsbad shall adopt a Green Building Code with a standard of five percent improvement in energy efficiency above CALGreen, which would also apply to any subsequent updates of the CALGreen Building Code. The Green Building Code would apply to new construction within the city.

Costs and Benefits:

Private: Private costs would occur in implementing the improvements in energy efficiency above the CALGreen code in new construction.

City: There is no cost to the City of Carlsbad, other than adopting the ordinance.

4.6 Efficient Lighting Standards

Measure I: Promote Replacement of Incandescent and Halogen Bulbs with LED or Other Energy Efficient Lamps	
Goal: Replace 50 percent of incandescent and halogen light bulbs citywide with LED or similarly efficient lighting by 2035.	2035 Reduction: 21,900 $MTCO_2e$
Actions: *I-1:* *Replace 50 percent of incandescent or halogen light bulbs in city facilities with LED or similarly efficient lighting, or follow SANDAG Energy Roadmap recommendations for lighting in city facilities, whichever results in greater energy savings.* (Short-term) *I-2*: P*romote the use of LED or other energy efficient lamps by publicizing rebate programs and information from SDG&E on the benefits of the use of LED or other energy efficient lighting on the city's webpage.* (Short-term) *I-3:* *Evaluate the feasibility of adopting a minimum natural lighting and ventilation standard, developed based on local conditions.* (Mid-term)	

Already-Projected Amount: There are no projections for this measure.

Target: The target is to replace 50 percent of incandescent and halogen bulbs citywide with LED bulbs or similarly efficient lighting by 2035.

GHG Reduction Measure Description: Replace inefficient incandescent and halogen light bulbs with more efficient light bulbs to reduce the amount of energy needed to power the bulbs, which will reduce the demand for electricity and thus the amount of GHG emissions created by the electrical power generation. Under AB 1109 (2007), minimum energy efficiency standards are structured to reduce statewide electrical consumption by 50 percent

or greater from 2007 levels for indoor residential lighting and by 25 percent or greater from 2007 levels for indoor commercial and outdoor lighting by 2018. The improved efficiency standards from AB 1109 will help to meet the goals of this measure. SANDAG is preparing an Energy Roadmap for the city, which may include lighting replacement recommendations for city facilities. Either the measures in the Energy Roadmap or the goal of 50 percent of incandescent and halogen light bulbs will be followed for city facilities, whichever results in greater energy savings.

Quantification of GHG Emissions Reductions: An estimated 17 percent of residential and commercial energy nationwide[35] and about 25 percent in California[36] is used for lighting. Applied to citywide energy use, 25 percent corresponds to about 78,000 $MTCO_2e$ of forecast emissions in 2035 (from the SEEC community forecast with General Plan land use and roadways). LED light bulbs reduce energy consumption and therefore GHG emissions by 75 percent[37] compared to incandescent lighting. This measure assumes that about 75 percent of the bulbs citywide are currently incandescent or halogen, and sets the target of replacing half of these bulbs[38] with more efficient ones by 2035. New construction could set at a goal of 75 percent of bulbs to be LED or similarly efficient. This would overall lead to a 28 percent[39] decrease in emissions compared to halogen/incandescent bulbs, which equates to emissions reductions of 21,900 $MTCO_2e$.

Responsibility and Implementation: Carlsbad's street lights were replaced in 2011 with energy-saving induction units, leading to a reduction of approximately 1,240 $MTCO_2e$ per year (already taken into account). The City has been and will continue to replace light bulbs within City facilities with LED or similarly efficient lighting. For residential and commercial customers, SDG&E currently does not offer rebates for the purchase of LED or similarly efficient lighting, but the City will promote rebates as they come available on its website and by other means. The City will also provide information on the benefits of the use of LED and efficient lighting from SDG&E and other sources.

Costs and Benefits:

Private: Private costs would be from purchasing LED light bulbs for new construction, and replacing existing light bulbs over time. Benefits would be from reduced energy costs and reduced cost to replace light bulbs (as LED lights last substantially longer).

City: City costs would come from replacing existing inefficient lighting in City facilities with more efficient light bulbs over time, providing information to homeowners and business

[35] http://www.eia.gov/tools/faqs/faq.cfm?id=99&t=3

[36] California Public Utilities Commission; http://www.cpuc.ca.gov/NR/rdonlyres/6234FFE8-452F-45BC-A579-A527D07D7456/0/Lighting.pdf

[37] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=LB

[38] It is estimated that 75 percent of lighting within the City is currently incandescent.

[39] 75 percent reduction in energy use in half of the 75 percent total incandescent bulbs is (75 percent)*(75 percent)*(50 percent)= 28 percent reduction

owners to encourage a switch to LED or other efficient lamps, and evaluating the feasibility of a natural lighting and ventilation ordinance.

4.7 Solar Water Heater/Heat Pump Installation

Measure J: New Construction Residential and Commercial Solar Water Heater Installation	
Goal: Install solar water heaters or heat pumps on all new residential and commercial construction. Retrofit up to 30 percent of existing homes and commercial buildings to include solar water heaters or heat pumps.	2035 Reduction: 11,604 $MTCO_2e$
Actions: *J-1: Promote the installation of solar water heaters and heat pumps by publicizing incentive, rebate and financing programs, such as PACE programs and the California Solar Initiative for renovations of existing buildings by posting this information on the city's website and by other means. (Short-term)* *J-2: Adopt residential and commercial energy conservation ordinances requiring new residential and commercial buildings to install solar water heaters or heat pumps, or use alternative energy (such as PV-generated electricity) for water heating needs. (Mid-term)*	

Already-Projected Amount: There are no solar water heaters/heat pumps projected to be installed.

Target: The target is to install solar water heaters or heat pumps on all new residential and commercial construction, and retrofit up to 30 percent of existing homes and commercial buildings to include solar water heaters or heat pumps.

GHG Reduction Measure Description: Solar water heaters use water heated by the sun to provide domestic and commercial hot water. Solar water heaters reduce the demand for energy used to heat water. A solar water heater can contribute 30 to 80 percent[40] of the energy needed for residential water heating. Heat pumps are devices that use a small amount of energy to move heat from one location to another.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure J.

Responsibility and Implementation: The three PACE programs described in Measure A also provide financing for the installation of solar water heaters and heat pumps to improve residential energy efficiency. The California Solar Initiative has a low-income solar water heating rebate program and solar thermal program, which offers rebates for solar water heaters. Installation of solar water heaters on all new residential and commercial water

[40] California Energy Commission. 2009. Go Solar California: A Step by Step Tool Kit for Local Governments to Go Solar. Available: http://www.energy.ca.gov/2009publications/CEC-180-2009-005/CEC-180-2009-005.PDF.

heaters could occur through city ordinance. Retrofit of existing homes could occur through a combination of additional encouragement and incentives.

Costs and Benefits:

Private: Private costs would occur through the installation of residential and commercial solar water heaters, which would be passed onto building owners. Benefits would occur through reduced water heating costs.

City: City costs would occur from adopting and enforcing an ordinance requiring new homes and commercial buildings to install solar water heaters or heat pumps.

4.8 Transportation Demand Management

Measure K: Promote Transportation Demand Management Strategies	
Goal: Promote Transportation Demand Management Strategies with a goal of achieving a 10 percent increase in alternative mode use by workers in Carlsbad, for a total of 32 percent alternative mode use.	2035 Reduction: 23,549 $MTCO_2e$
Actions: *K-1: Adopt a citywide transportation demand management (TDM) plan, as described in the General Plan Mobility Element, detailing a mix of strategies to reduce travel demand, specifically of single occupancy vehicles. SANDAG's 2012 "Integrating Transportation Demand Management Into the Planning and Development Process"[41] provides a guide to designing and implementing a TDM plan and will be used as a reference document to develop the city's TDM plan. TDM strategies evaluated in the plan include parking ordinances, subsidized or discounted transit programs, transit marketing and promotion, carsharing, parking pricing, and bike parking.* (Mid-term) *K-2: Adopt a TDM ordinance, defining a minimum trip generation threshold for nonresidential development projects. The city will set performance requirements for minimum alternative mode use based on project type. All projects above the threshold shall submit a TDM plan, which includes a description of how the minimum alternative mode use will be achieved and maintained over the life of the project. Potential TDM trip reduction measures can include carpool and vanpool ridematching services; designated employees as contacts for trip reduction programs; providing a direct route to transit in coordination with NCTD; developing public-private transit partnerships; passenger loading zones; pedestrian connections; showers and clothes lockers; long–term bicycle parking and shuttle programs.* (Mid-term)	

Already-Projected Amount: There are no projections for this measure. As of 2012[42], alternative (non-single occupancy vehicle use—such as working at home, carpooling, transit,

[41] Available: http://www.icommutesd.com/documents/tdmstudy_may2012_webversion_000.pdf.

[42] American Community Survey. 2012. Selected Economic Characteristics for Carlsbad, California. Available: http://factfinder2.census.gov/.

walking and biking) mode use by Carlsbad workers is 22 percent. Of these alternative uses, most workers work at home (44 percent) and carpool (36 percent), followed by public transit (10 percent), other means (including biking, 6 percent), and walking (5 percent).

Target: The Carlsbad General Plan promotes the use of Transportation Demand Management (TDM), but does not specify a target goal. This measure specifies a goal of achieving an additional 10 percent use of alternative modes, for an overall 32 percent alternative mode use by workers employed in Carlsbad. This is projected to be achieved through 40 percent alternative mode use by workers in new nonresidential buildings, and 30 percent alternative mode use by workers in existing (as of 2013) nonresidential buildings.

GHG Reduction Measure Description: Chapter 3 quantifies emissions reductions from the Carlsbad General Plan due to bikeway system improvements, pedestrian improvements, traffic calming, parking facilities and policies, and transportation improvements. This measure is distinct from these reductions because it focuses on TDM, or the application of strategies and policies to reduce travel demand, or redistribute it in time and space. This measure reduces VMT by shifting single occupancy vehicle use to alternative modes, reducing the average commute length, promoting an alternate work schedule, and promoting telecommuting.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure K.

Responsibility and Implementation: The City of Carlsbad will develop a TDM plan describing strategies to reduce travel demand. The city will also develop an ordinance applying to nonresidential developments meeting a specified minimum trip generation threshold, providing connections to public transportation whenever possible. The city will facilitate a coordinated effort between local businesses and NCTD to develop a route expansion and ridership plan wherever feasible. SANDAG's iCommute program assists commuters by providing free carpool and ridematching services, a subsidized vanpool program, the Guaranteed Ride Home program, SchoolPool carpooling programs for parents, and information about teleworking, all of which can support the city's TDM goals.

Costs and Benefits:

Private: Private costs could include need for a TDM coordinator for private businesses, providing on-site facilities (showers, lockers), and shuttle programs. Benefits would accrue from reduced spending on gasoline, and reduced traffic from less employee commute.

City: City costs would result from developing, implementing, and enforcing a TDM plan and ordinance. Implementation costs would include conducting an outreach and education campaign to promote the benefits of TDM.

4.9 Increased Zero-Emissions Vehicle (ZEV) Travel

Measure L: Promote an Increase in the Amount of Zero-Emissions Vehicle Travel	
Goal: Promote an increase in the amount of ZEV[43] miles traveled from a projected 15 percent to 25 percent of total vehicle miles traveled by 2035.	2035 Reduction: 54,158 $MTCO_2e$
Actions: *L-1: Working with industry partners, construct a "PV to EV" pilot project to install a PV charging station at a city facility (such as the Faraday Center), to charge city ZEVs. The purpose of the pilot project would be to evaluate the feasibility of incorporating more ZEV into the city's fleet. (*Short-term*)* *L-2: Prepare a community-wide charging station siting plan, which evaluates site visibility and exposure, EV driving ranges, high volume destinations, locations with high ownership or interest in EVs, and cost of construction.* (Short-term) *L-3: Construct ZEV charging stations based on the community-wide charging station siting plan described in L-1 above. The ZEV charging stations will be funded by grant funds when available, and the city will post signage directing ZEVs to charging stations.* (Mid-term) *L-4: Offer dedicated ZEV parking, and provide charging stations adjacent to ZEV parking as identified in the community-wide charging station siting plan.* (Mid-term) *L-5: Adopt requirements for ZEV parking for new developments.* (Mid-term) *L-6: Adopt a residential energy conservation ordinance, similar to Palo Alto, requiring the installation of EV chargers or pre-wiring in new residential construction and major renovations.* (Mid-term) *L-7: Update the city's Fleet Management Program to include a low and zero-emissions vehicle replacement/purchasing policy. Increase the proportion of fleet low and zero–emissions vehicle miles traveled to 25 percent of all city-related VMT by 2035.* (Mid-term)	

Already-Projected Amount: According to the EPIC mitigation calculator, 15 percent of the vehicle miles traveled in 2035 are projected to be from ZEVs.

Target: The target is to increase the proportion of vehicle miles traveled from 15 percent to 25 percent by the year 2035.

GHG Reduction Measure Description: Driving ZEVs reduces carbon emissions by eliminating direct tailpipe emissions of carbon dioxide and other GHGs. The production of electricity used to power electric vehicles generates GHGs; however, SDG&E electricity generates much less GHGs than the direct combustion of fossil fuels. Furthermore, electric vehicles can be charged at home or the workplace using energy produced by PV panels, eliminating GHG emissions completely, at least for the months when PV panels produce the full amount of electricity needed for operations. The ability to provide entirely emissions-free

[43] Zero-Emissions Vehicle (ZEV) is a vehicle that emits no tailpipe pollutants from the onboard source of power. ZEVs include electric vehicles, fuel cell vehicles, and plug-in hybrids, when in electric mode.

transportation through the use of PV panels to charge ZEVs should be capitalized on whenever possible.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure L.

Responsibility and Implementation: The city will promote an increase in the amount of electric vehicle travel by constructing ZEV charging stations using the community-wide station siting plan. Grant funding for the construction of the ZEV charging stations can come from the California Energy Commission's Electric Vehicle Charging Infrastructure grant, or other similar grant programs. The city would be responsible for operating (including electricity provision, for stations not using PV panels) and maintaining charging stations.

The city will also promote the use of ZEVs by offering dedicated ZEV parking and adopting requirements for ZEV parking for new development. The city will create an ordinance requiring the installation of ZEV chargers or pre-wiring in new residential construction and major renovations.[44] The City of Carlsbad will increase the city fleet mix of ZEVs, hybrids, and other low- or zero-emissions vehicles to increase low and zero–emissions vehicle miles traveled to 25 percent by 2035.

Costs and Benefits:

Private: The private cost would be the purchase of an electric vehicle and the cost of electricity to power the electric vehicle, for community members who elect to purchase an electric vehicle. Costs may also occur from installing EV chargers or pre-wiring into new residential construction or major renovations. Benefits would accrue from reduced spending on gasoline.

City: City costs would be from planning for, constructing, operating (including providing electricity, for stations not using PV panels) and maintaining ZEV charging stations, which may be offset by potential user fees or grants from the California Energy Commission, or other similar agencies. City costs may occur from developing ordinances to require the installation of ZEV chargers in new residential construction and major renovations. City costs may also occur from fleet purchases of ZEV vehicles. Benefits would accrue from reduced spending on gasoline.

[44] Assembly Bill 1092 (2013) requires the Department of Housing and Community Development to propose minimum building standards for the installation of future electric vehicle charging infrastructure for parking spaces in multi-family dwellings and nonresidential development.

4.10 Citywide Renewable Projects

Measure M: Develop More Citywide Renewable Energy Projects	
Goal: Produce the equivalent amount of energy to power 2,000 homes (roughly equivalent to a 5 percent reduction) by 2035 from renewable energy projects.	2035 Reduction: 4,580 $MTCO_2e$
Actions: *M-1: Conduct a feasibility study to prioritize citywide renewable energy projects. (Short-term)* *M-2: Incorporate renewable energy measures such as PV system installation on city buildings and parking lots, or microturbine installation on city facilities, with the goal of producing approximately 12,000 megawatt-hours per year.* (Long-term) *M-3: Pursue available funding sources for the construction of renewable energy projects by the city, such as Energy Efficiency Financing for Public Sector Projects and SGIP.* (Long-term)	

Already-Projected Amount: There is no projected amount for this measure.

Target: The target is the production of 12,341 megawatt-hours per year, approximately the energy required to power 2,000 homes.

GHG Reduction Measure Description: The City of Carlsbad has a number of renewable energy projects in various stages of planning and development. The Maerkle Reservoir Hydropower Project, which has been permitted by the Federal Energy Regulatory Commission (FERC), is estimated to produce about 833 MWh per year. Other planned projects include a second pressure-reducing hydroelectric generator, similar to the Maerkle Reservoir Hydropower Project, and a potential solar PV project in Alga Norte Community Park.

Quantification of GHG Emissions Reduction: The production of 12,341 megawatt-hours per year was converted into $MTCO_2e$ using the 2010 SDG&E coefficient of 742.2 lb CO_2e per megawatt-hour. This corresponds to a reduction of 4,580 $MTCO_2e$.

Responsibility and Implementation: The City of Carlsbad would be responsible for conducting a feasibility study, determining suitable renewable technologies, siting renewable projects, and constructing and maintaining the renewable energy projects. Funding sources include the Energy Efficiency Financing for Public Sector Projects, which includes renewable energies such as PV systems and other distributed generation technologies, as well as the SGIP, as described above in Measure C.

Costs and Benefits:

Private: There are no direct private costs from this measure.

City: City costs are planning (including a feasibility study), constructing and maintaining the renewable facilities, some of which may be offset through the funding sources described above. Benefits accrue from electricity savings to City through net energy metering.

4.11 Water Utilities System Improvements

Measure N: Reduce GHG Intensity of Water Utilities[45] Supply Conveyance, Treatment, and Distribution	
Goal: Reduce the intensity of GHG emissions from water utilities (including water supply, wastewater, and recycled water) conveyance, treatment, and distribution by 8 percent by 2035.	2035 Reduction: 5,968 $MTCO_2e$
Action: *N-1: Improve water utilities (including water supply, wastewater, and recycled water) conveyance, treatment and distribution, and other system improvements.* (Long-term)	

Already-Projected Amount: The goal of an 8 percent reduction by 2035 is the default value in the EPIC mitigation calculator.

Target: The target is to achieve the already-projected amount.

GHG Reduction Measure Description: This measure estimates emissions reductions from changes in the efficiency of water utilities (including water supply, wastewater, and recycled water) conveyance, treatment, and distribution facilities within the City of Carlsbad.[46] This combines improvements in overall system efficiency, the reduction in GHG intensity of electricity used to move water, wastewater, and recycled water, and replacing potable water needs with expanded recycled water supply. Carlsbad's Sewer Master Plan, for example, calls for eliminating several sewer lift stations and replacing them with gravity pipelines, which would reduce energy usage.[47] The Encina Water Pollution Control Facility exemplifies GHG reductions from water treatment; the facility currently is able to satisfy 60 percent of its energy needs through methane capture and cogeneration and has a long-term goal of energy independence from purchased energy. The 2012 Carlsbad Municipal Water District Recycled Water Master Plan estimates that, by 2030, recycled water demand could double from 4,100 acre-feet/year to about 9,100 acre-feet/year. Expanding the recycled water system would appreciably reduce the need for more expensive imported water needs in the future.

Quantification of GHG Emissions Reduction: The EPIC mitigation calculator was used to quantify emission reductions for Measure N, which estimates wastewater emissions

[45] For purposes of this measure, water utilities include potable water treatment and conveyance, sewer conveyance, and recycled water treatment and conveyance systems.

[46] Note: The GHG reductions from water conservation measures detailed in the 2010 Carlsbad Municipal Water District Urban Water Management Plan (UWMP) have already been considered in the GHG forecasts. Further GHG reductions may be possible through greater conservation efforts than those outlined in the UWMP, including Ordinance No. 44 (2009); however, these have not been quantified in this CAP.

[47] The City is replacing three sewer lift stations, which use a combined total of approximately 6,200 kWh of electricity per year with gravity pipelines, in addition to other planned rehabilitation upgrades included in the Sewer Master Plan.

reductions from methane capture, reductions from water treatment and distribution facilities, and changes in the supply network, including greater use of recycled water.

Responsibility and Implementation: The City of Carlsbad would be responsible for making the improvements to water supply conveyance, treatment, and distribution, which could occur through improvements to the Carlsbad Municipal Water District's system.

Costs and Benefits:

Private: There would be no private costs for this measure.

City: Costs to the City of Carlsbad are from implementing the improvements to the water utilities system. Benefits occur by reducing energy costs and having newer water delivery infrastructure.

Measure O: Encourage the Installation of Greywater and Rainwater Collection Systems	
Goal: Encourage the installation of greywater and rainwater collection systems with a goal of 15 percent of homes by 2035.	2035 Reduction: 1,205 $MTCO_2e$
Actions: *O-1:* *Host workshops on greywater and rainwater collection systems through the Carlsbad Municipal Water District, or partner with existing workshop providers, for homeowners interested in installing systems suitable for their property.* (Mid-term) *O-2:* *Create a design reference manual, or provide links to an existing one, for the design of greywater and rainwater collection systems.* (Mid-term) *O-3:* *Evaluate the feasibility of offering a rebate for residential greywater systems that require a permit to cover the cost of obtaining a permit.* (Mid-term)	

Already-Projected Amount: There is no projection for this measure.

Target: The target is for fifteen percent of homes to have greywater and rainwater collection systems installed by 2035.

GHG Reduction Measure Description: Greywater is wastewater generated from hand washing, laundry machines, and showers and baths that have not been contaminated by any toilet discharge. Greywater can be recycled onsite for toilet flushing and subsurface (below ground) landscape irrigation using a greywater system. The regulations for the design, construction and use of greywater systems are in Chapter 16A of the California Plumbing Code. Some small greywater systems that involve laundry machines or single fixtures only are exempt from permits. More complicated greywater systems require building permits from the City. Rainwater harvesting is the practice of collecting rainwater from hard surfaces, such as roofs, and storing it in barrels or cisterns, which can be used for landscape irrigation. Measure O is to promote the use of on-site greywater and rainwater collection systems for residences.

Quantification of GHG Emissions Reductions: Nationwide, about seven percent of U.S. GHG emissions are from water and wastewater service provision to urban populations.[48] For this measure, it was assumed that seven percent of the citywide emissions are from water provision and wastewater services.[49] Therefore, about 32,000 $MTCO_2e$ of 2035 emissions are from water provision and wastewater services.

If maximally pursued, the use of greywater and rainwater collection systems could reduce water demands by 25 percent on a statewide scale.[50] For this measure, it was assumed the 25 percent reduction in water demand would scale to individual houses that implement greywater and rainwater collection systems. A goal of 15 percent of homes with greywater and rainwater harvesting systems was chosen. A 25 percent reduction of water use in 15 percent of homes corresponds to a GHG reduction of about 1,205 $MTCO_2e$.

Responsibility and Implementation: Homeowners would be responsible for the installation of greywater and rainwater collection systems. The City of Carlsbad will, through the Carlsbad Municipal Water District, host greywater and rainwater harvesting workshops, or partner with existing workshop providers. The City will also reference or develop a greywater and rainwater collection system design manual and consider offering a rebate for residential greywater systems that require a permit to cover the cost of obtaining a permit.

Costs and Benefits:

Private: Costs to homeowners would be from constructing and maintaining greywater and rainwater collection systems. Benefits would accrue over time through water savings.

City: Costs to the City of Carlsbad are from hosting workshops and developing or reviewing greywater and rainwater collection manuals to adopt.

4.12 Combined Effect of CAP GHG Reduction Measures and Forecast with CAP

Table 4-1 shows a summary of the CAP GHG reduction measures. While the individual measures may be implemented over different timescales, for the purposes of calculating their impact in this section, it was assumed that the effect of all measures would begin in the mid-term time frame and increase linearly to reach the full reduction potential in the year 2035. Table 4-2 shows proposed residential energy conservation, commercial energy conservation, and transportation demand management ordinances adjacent to the applicable reduction measures.

[48] Source: V. Novotny. 2010. "Urban Water and Energy Use: From Current US Use to Cities of the Future." *Cities of the Future/Urban River Restoration*. Water Environment Federation. 9: 118-140.

[49] The 7 percent estimate was used for the purpose of this reduction measure because the Chapter 2 inventory did not directly quantify all emissions associated with water use, but rather included those as part of commercial, industrial and residential energy use (e.g. heating water).

[50] Source: J. Loux, R. Winer-Skonovd, E. Gellerman. 2012. "Evaluation of Combined Rainwater and Greywater Systems for Multiple Development Types in Mediterranean Climates." *Journal of Water Sustainability*. 2(1): 55-77.

As a whole, the CAP GHG reduction measures were designed to enable Carlsbad to achieve its GHG reduction target in the year 2035. The combined GHG reduction from these measures is 185,919 $MTCO_2e$ in 2035, which cover the emissions "gap" identified in Chapter 3. Table 4-3 adds the effect of the CAP GHG reduction measures to the community forecast, and compares the resulting forecast with CAP GHG reduction measures to emission targets. As proposed, this CAP meets the emissions targets for both 2020 and 2035. Figure 4-1 shows the forecast with CAP reduction measures compared to the emissions targets to demonstrate that both 2020 and 2035 targets will be met with the implementation of this CAP.

For this CAP to successfully be implemented, the City of Carlsbad must play a prominent role in implementing the CAP GHG reduction measures. In addition to responsibility and implementation covered for each measure in this chapter, the following chapter discusses how the CAP will be revised and updated in the future to ensure that the targets are met.

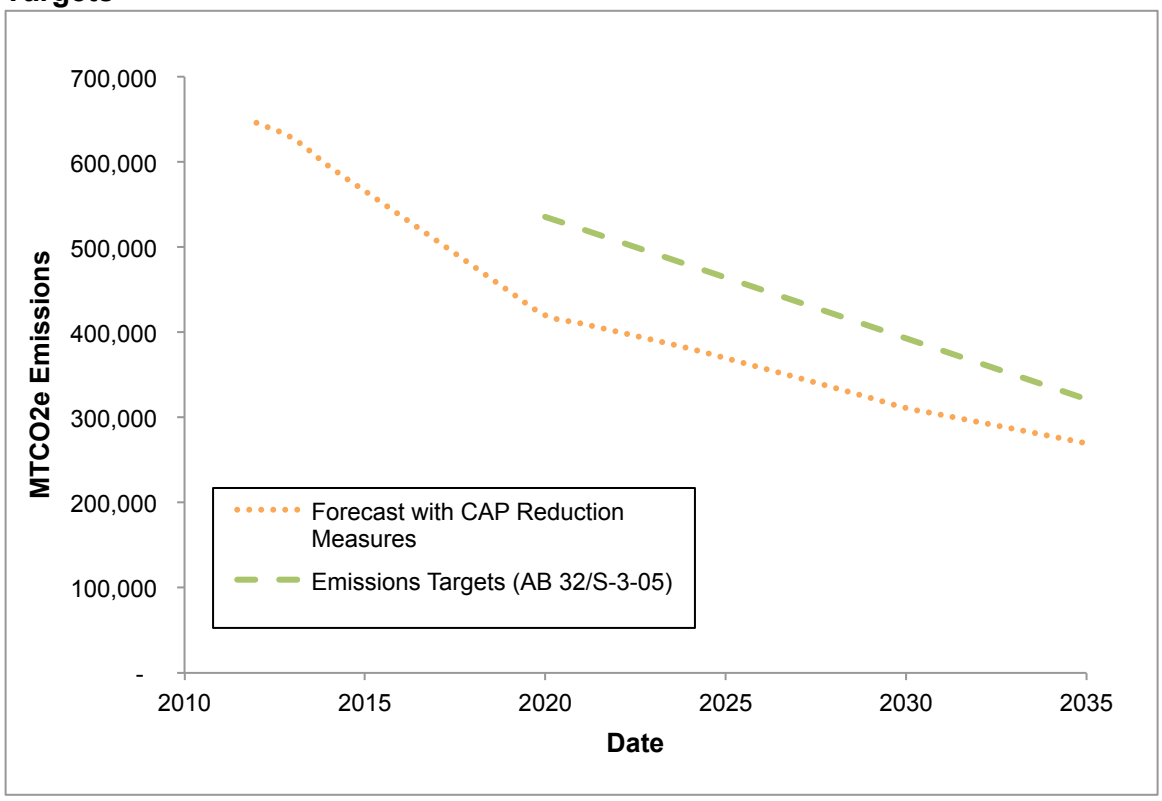
TABLE 4-1: CAP GHG REDUCTION MEASURES SUMMARY

Measure Letter	GHG Reduction Measures	GHG Reduction in 2035 ($MTCO_2e$)
A	Install residential PV systems	10,136
B	Install commercial and industrial PV systems	13,336
C	Promote building cogeneration for large commercial and industrial facilities	1,067
D	Encourage single-family residential efficiency retrofits	1,132
E	Encourage multi-family residential efficiency retrofits	351
F	Encourage commercial and city facility efficiency retrofits	18,377
G	Promote commercial and city facility commissioning, or improving building operations	18,377
H	Implementation of Green Building Code	179
I	Replace Incandescent bulbs with LED bulbs	21,900
J	New construction residential and commercial solar water heater/heat pump installation & retrofit of existing residential	11,604
K	Promote Transportation Demand Management	23,549
L	Increase zero-emissions vehicle travel	54,158
M	Develop more citywide renewable energy projects	4,580
N	Reduce the GHG intensity of water supply conveyance, treatment and delivery	5,968
O	Encourage the installation of greywater and rainwater systems	1,205
Total GHG Reductions		**185,919**

TABLE 4-2: LIST OF PROPOSED ORDINANCES AND APPLICABLE MEASURES	
PROPOSED ORDINANCES	**Applicable Measures**
Residential Energy Conservation Ordinance	A[1], D, E, H, I, J, L
Commercial Energy Conservation Ordinance	B, F, H, I, J, L
Transportation Demand Management Ordinance	K
[1] *If solar panel requirement found feasible*	

TABLE 4-3: FORECAST COMMUNITY EMISSIONS WITH CAP GHG REDUCTION MEASURES AND TARGETS					
Year	**Modified Baseline Forecast (From Chapter 3) ($MTCO_2e$)**	**CAP GHG Reduction Measures (Phased in Linearly to 2035) ($MTCO_2e$)**	**Forecast Community Emissions with CAP GHG Reduction Measures**	**GHG Emission Targets (Linear Scaling of AB 32/S-3-05) ($MTCO_2e$)**	**Emission Target Met?**
2020	473,082	53,120	419,962	535,763	Yes
2035	455,556	185,919	269,639	321,458	Yes

Figure 4-1: Forecast Community Emissions with CAP Reduction Measures and Targets



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5

Project Review Checklist and Monitoring Progress

This chapter describes how the City of Carlsbad will review development projects to achieve the reduction measures in Chapter 4, consistent with State CEQA Guidelines Section 15183.5(b)(1)(D).

For discretionary projects seeking to use CEQA streamlining provisions, in an environmental document the city may refer to the required measures in this CAP as mandatory conditions of approval or as mitigation. This will enable projects to benefit from CEQA streamlining provisions, while ensuring that the city can achieve the reduction targets outlined in this plan.

5.1 Project Review Thresholds and Checklist

Compliance with CAP

During the course of project review, city will evaluate whether a project is subject to provisions of this CAP, using the screening criteria below. Once this is established, a project can comply with the CAP in one of two ways:

- **Checklist Approach.** The Project Review Checklist below provides direction about measures to be incorporated in individual projects, which will be used during the normal development review process. Project features that help a project meet the provisions of the CAP would then become part of project conditions of approval.
- **Self-Developed Program Approach.** Rather than use the standard checklist, project proponents can develop their own program that would result in the same outcome as the checklist; approval would be subject to city review.

CEQA Streamlining

Project Review Checklist

The Project Review Checklist is applicable for all land use development projects subject to CEQA review. The County of San Diego's 2013 Guidelines for Determining Significance for

Climate Change were used to establish a "bright line" threshold of 2,500 $MTCO_2e$ per year.[51] Table 5-1 lists the project review thresholds for a range of project types and sizes to identify the "bright line" threshold; projects equal to or exceeding these thresholds would be subject to CAP measures.[52]

TABLE 5-1: PROJECT REVIEW THRESHOLDS

Project/Plan Type	Screening Threshold
Single-Family Housing	85 dwelling units
Multi-family Housing	130 dwelling units
Assisted Living Facility	240 dwelling units
University/College (four years)	336 students
Library	81,000 square feet
Restaurant	12,000 square feet
Hotel	100 rooms
Retail Store/Shopping Center	30,000 square feet
Convenience Market (24 hour)	2,000 square feet
Office	60,000 square feet
Hospital/Medical Office	45,000 square feet
Warehouse	140,000 square feet
Industrial	75,000 square feet

Source: Adapted from Table 3, 2013 County of San Diego Guidelines for Determining Significance for Climate Change.

Note: Proposed project land use types will be compared with the land use types included in the screening table above to determine applicability. A shopping center includes a group of commercial establishments that is developed as a unit. Industrial facilities would typically involve assembly of processed or partially processed materials into products and would have an energy demand that is not substantially higher than office buildings of the same size and scale. Industrial facilities would not typically generate dust, other air pollutants, light, or noise that it perceptible beyond the boundary of the subject property.

For proposed projects above the screening thresholds, project proponents should complete the CAP Project Review Checklist (Table 5-2). For each item on the checklist, project proponents should indicate whether or not the measure is included as part of the project, or if it is not applicable. The checklist is designed to meet the targets set for the measures presented in Chapter 4. The checklist is preliminary and illustrative of the items of that will

[51] The City of San Diego's 2013 Draft Significance Thresholds for Greenhouse Gas Emissions contain the same bright line threshold of 2,500 $MTCO_2e$. The methodology used to develop the threshold is referred to as the "gap-based approach," and is described in detail in both the City's draft and County's adopted significance thresholds.

[52] If a proposed project is below the screening criteria, GHG emissions would still be reduced through compliance with applicable City of Carlsbad ordinances and regulations.

be included in the finalized checklist. The city will provide a final checklist incorporating requirements in ordinances drafted for the CAP.

TABLE 5-2: PRELIMINARY CAP PROJECT REVIEW CHECKLIST		
RENEWABLE ENERGY PRODUCTION		
1. For new nonresidential projects with more than 50 cars surface parked or on roofs of parking structures, would the project include PV panels over at least half of the surface/roof-parked cars or other equivalent renewable energy production?	☐ Included	☐ Not Applicable
Explanation: *Describe the measures taken to meet this requirement, if applicable.*		
COGENERATION		
2. For the construction or retrofit of a large commercial or industrial facility with an on-site electricity production, would the proposed project include a building cogeneration system?	☐ Included	☐ Not Applicable
Explanation:		
ENERGY CONSERVATION ORDINANCES		
3. For residential and commercial construction or renovations in excess of $50,000, would the proposed project meet the requirements in the applicable energy conservation ordinance?	☐ Included	☐ Not Applicable
Explanation:		
GREEN BUILDING CODE		
4. Would the proposed project meet the energy efficiency standard of 5 percent above Title 24 standards (CALGreen)?	☐ Included	☐ Not Applicable
Explanation:		

TABLE 5-2: PRELIMINARY CAP PROJECT REVIEW CHECKLIST		
SOLAR WATER HEATERS/HEAT PUMPS		
5. For residential and commercial projects, does the project include solar water heaters to reduce the energy needed for residential water heating by 50 percent, or heat pumps to reduce the heating/cooling load by 50 percent?	☐ Included	☐ Not Applicable
Explanation:		
TRANSPORTATION DEMAND MANAGEMENT		
6. For proposed projects that meet the minimum trip generation thresholds set in the City of Carlsbad Transportation Demand Management (TDM) ordinance, does the project include a TDM plan, containing a description of how minimum alternative mode use will be achieved and maintained over the life of the project?	☐ Included	☐ Not Applicable
Explanation: *Include TDM plan if applicable.*		
ZERO-EMISSIONS VEHICLES		
7. For proposed projects subject to the City of Carlsbad off-street parking requirements, does the proposed project provide preferential parking for electric vehicles and/or charging stations for electric vehicle use?	☐ Included	☐ Not Applicable
Explanation:		
OTHER GHG REDUCTION MEASURES AND/OR FEATURES		
8. Describe other GHG reductions measures and/or features of the proposed project:	☐ Included	☐ Not Included
Explanation:		

A completed CAP Project Review Checklist, including supporting documentation for applicable measures, demonstrates a proposed project complies with the CAP.

5.2 Monitoring Progress

This CAP serves as a toolkit for the City of Carlsbad to reduce community-wide GHG emissions and meet emissions targets. Climate action planning, however, is an iterative process, and requires monitoring progress and periodically revisiting assumptions and provisions. Figure 5-1 shows the steps in the process of climate action planning.

Figure 5-1: Process of Climate Action Planning

(Source: CoolCalifornia, http://www.coolcalifornia.org/article/climate-action-planning)

To continue the process of climate action planning, the City of Carlsbad will follow these steps:

- Monitoring
- Updating GHG inventory and the CAP
- Update Project Review Checklist

Monitoring

The City of Carlsbad will periodically monitor and report on progress towards achieving the emissions targets. This periodic assessment will contain data on residential, industrial, and commercial energy use. New opportunities for GHG reductions, including new funding sources and the ability to link city reduction actions to the city's Capital Improvement Plan and other programs can also be incorporated into future updates of the CAP.

Updating GHG Inventory and the CAP

As part of the periodic monitoring assessments, the city will assess whether information on GHG inventory or targets is substantially out of date. If so, the city will take necessary actions to update the inventory and goals and actions that reflect the adoption of new technologies and programs to reduce GHG emissions.

Updating Project Review Checklist

The Project Review Checklist will be finalized by the City of Carlsbad and updated as necessary to reflect lessons learned through project streamlining. Federal, state, and San Diego Air Pollution Control District actions will be monitored to identify future changes to federal or state standards or guidelines that affect implementation of the CAP. Any changes to California Environmental Quality Act (CEQA) Guidelines will also be integrated into the Project Review Checklist.

Appendix A

Climate Change Informational Resources

Combating climate change requires education and personal action. This section contains resources on climate change and its impacts, calculating individual carbon footprints, and ways to reduce individual carbon footprints.

Education

The evidence is clear that climate change is happening. Humans are largely responsible for recent climate change. International scientific bodies, federal agencies, and state agencies have numerous resources that summarize the current scientific understanding of climate change and the latest projections of climate change impacts.

The Intergovernmental Panel on Climate Change is the leading international body for the assessment of climate change:

- http://www.ipcc.ch/

The National Aeronautics and Space Administration (NASA) has documented recent impacts and future trends of climate change:

- http://climate.nasa.gov/effects

The U.S. Environmental Protection Agency (U.S. EPA) has information of climate change, and it's effects:

- http://www.epa.gov/climatechange/basics/

Cal-Adapt, a product of the Public Interest Energy Research (PIER) program, funded by the California Energy Commission, provides California-specific climate change research, including interactive climate tools:

- http://cal-adapt.org/

Carbon Footprint

A carbon footprint is a measure of the total amount of GHG emissions produced by an individual. It can be thought of as a personal inventory of one's impacts on climate change.

There are a number of online calculators that estimate personal carbon footprints. Individuals can use the following carbon footprint calculators as a guide to help reduce personal carbon emissions.

U.S. Environmental Protection Agency (EPA)

- http://www.epa.gov/climatechange/ghgemissions/ind-calculator.html

Cool California

- http://www.coolcalifornia.org/calculator

Cool Climate Network

- http://coolclimate.berkeley.edu/carboncalculator

Nature Conservancy

- http://www.nature.org/greenliving/carboncalculator/index.htm

Conservation International

- http://www.conservation.org/act/live_green/carboncalc/Pages/default.aspx

Earth Lab

- https://www.earthlab.com/createprofile/reg.aspx

Carbon Footprint

- http://www.carbonfootprint.com/calculator1.html

EarthLab

- http://www.earthlab.com/carbon-footprint/California-carbon-calculator.aspx

Global Footprint Network

- http://www.footprintnetwork.org/en/index.php/gfn/page/calculators/

Reducing your Carbon Footprint

Reducing one's personal carbon footprint saves money, decreases impact on the environment, and helps fight climate change. The following links provide resources from federal and state agencies on changes one can make in his or her day-to-day life to diminish GHG emissions.

U.S. EPA: What can you do at home?

- http://www.epa.gov/climatechange/wycd/home.html

U.S. EPA: What can you do at school?

- http://www.epa.gov/climatechange/wycd/school.html

U.S. EPA: What can you do on the road?

- http://www.epa.gov/climatechange/wycd/road.html

U.S Department of Energy: Save energy, save money

- http://energy.gov/energysaver/energy-saver

California Environmental Protection Agency: Climate change resources for individuals

- http://www.climatechange.ca.gov/individuals.html

California Air Resources Board: Low emissions vehicles

- http://www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/consumer_acc.htm

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Appendix B

Carlsbad 2011 Community and Local Government Operations Greenhouse Gas Inventories

DYETT & BHATIA
Urban and Regional Planners

M E M O R A N D U M

To:	David de Cordova
From:	Chris Ford, Josh Pollak
Re:	Carlsbad Community Greenhouse Gas Inventory Update – 2011
Date:	August 26, 2013

This memo highlights the approach taken to update the City's 2005 Greenhouse Gas (GHG) Emissions Inventory with 2011 data and compares the inputs and outputs. A separate memo will cover local government operations. The content of these memos will then contribute to the summary of Carlsbad's GHG emissions in the forthcoming Climate Action Plan (CAP); the memos may be placed in an appendix to the CAP.

This memo reviews the assumptions employed, the quantitative inputs and methodology of estimating the emissions by sector, and the outputs.

Technical terms and acronyms that appear in this memo are listed in Table 1.

Table 1: Technical Terms and Acronyms

CACP	Clean Air and Climate Protection software, a model developed by ICLEI to inventory and forecast GHG emissions
CAP	Climate Action Plan
CARB	California Air Resources Board, the agency responsible for setting statewide GHG emission reduction targets. CARB also maintains several GHG emission calculation models.
CO_2e	Carbon dioxide equivalents, a measure of GHGs that converts non-CO_2 emissions to the same impact as carbon dioxide
EMFAC	The EMissions FACtors model developed by CARB to measure various emissions from vehicles. There are multiple versions of EMFAC which focus on different vehicle types.
EPA	US Environmental Protection Agency
GHG	Greenhouse gases, mainly carbon dioxide (CO_2), carbon dioxide, nitrous oxide (N_2O), and methane (CH_4)
ICLEI	An organization that provides standards and models for measuring and forecasting GHG emissions
SDG&E	San Diego Gas and Electric, the energy utility for Carlsbad
Service Population	Residents + employees, a rough measure of how many people may be generating emissions within a defined area.
VMT	Vehicle Miles Traveled, a measure of the annual amount of driving within an area, used to calculate GHG emissions from vehicles

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ASSUMPTIONS

As with the 2005 inventory, ICLEI's CACP[1] model was used to estimate emissions from residential, commercial, and industrial consumption of energy and solid waste disposal; CARB's EMFAC models were used to calculate transportation emissions; and other sources were used for wastewater and Palomar landfill emissions.

Between 2005 and 2011, the population and jobs of Carlsbad increased by an estimated 12 percent as did the service population of Carlsbad—the number of residents plus number of jobs, reflecting the number of people who may generate GHG emissions. Since 2005, Carlsbad's share of the county population has increased from 3.13 percent to 3.41 percent, due to a faster rate of growth than the overall county. Table 2 summarizes these changes.

Table 2: Population and Jobs, 2005 and 2011

	2005	*2011*	*% Change*
San Diego County Population[1]	3,034,388	3,115,810	2.7%
Carlsbad Population[1, 2]	94,961	106,403	12.0%
Carlsbad - % of County Population	3.13%	3.41%	8.9%
Carlsbad - # of Jobs[3]	59,309	66,417	12.0%
Carlsbad – Service Population	154,270	172,820	12.0%

1. The 2011 populations for the county and Carlsbad come from the California Department of Finance, Table E-5.
2. The 2005 Inventory used different populations for the community and local government analyses. This is the population used for the community inventory.
3. Numbers from SANDAG.

Electricity Coefficients

Electricity coefficients measure how much GHG emission and air pollution is created by various sources of electricity generation. They are measured as pounds of emission per megawatt hour (lb/MWh). The CACP model includes "back end" settings and assumptions that can be adjusted from defaults:

- Bundled customers purchase electricity from SDG&E. The CACP model has built-in values for SDG&E, although the most recent data is from 2007. Dudek provided 2010 numbers from SDG&E from the Climate Registry, which are the most recent available; these 2010 numbers were substituted in for the 2007 data.
- CACP also allows the manual entry of coefficients. This is used for direct electricity consumers, who purchase power from elsewhere, with SDG&E handling delivery to the customer. The power is purchased from across the region. We used the regional energy coefficients from the EPA's 2009 eGRID tables, which are the most recent available.

Table 3 compares the coefficients used for the 2005 and 2011 inventories. The table shows that since 2005, the pounds of GHG emissions (carbon dioxide, nitrous oxide, and methane) produced per megawatt hour of electricity fell for both SDG&E and regional power generation—except for

[1] The 2011 update utilized the CACP 2009 Version 3.0 software.

CO_2 emissions from SDG&E power, which rose significantly (35%). The reason for this difference is unknown; SDG&E would not respond to our questions. The coefficients for SDG&E in 2005 were notably lower than in all other recent years, however, with a major decline from 2004 to 2005, followed by large increases between 2005 and 2007, and thereafter. This pattern suggests that SDG&E's low energy coefficients for 2005 were abnormal, with the 2010 coefficients (used for the 2011 Inventory) more in line with recent trends.

A second issue shown by Table 3 is that in 2005, SDG&E power was significantly cleaner than power purchased from elsewhere (about 24% less CO_2), but by 2009-2010 SDG&E power produced more GHG emissions than other regional power (12% more CO_2).

Table 3: Electricity Coefficients (lb/MWh)

Year	*CO_2*	*N_2O*	*CH_4*
Bundled Service (SDG&E)			
2005[1]	546.50	0.011	0.030
2010[2]*	739.05	0.0081	0.0302
% Increase	*+35%*	*-26%*	*+1%*
Direct Access Electricity (eGRID)			
2005	724.12	0.00808	0.03024
2009[3]*	658.68	0.00617	0.02894
% Change	*-9%*	*-24%*	*-4%*

**Data used for Carlsbad 2011 inventory update.*

1. Data from CACP model.
2. Data from www.climateregistry.org
3. 2009 eGRID coefficients for N_2O and CH_4 converted from lb/GWh by dividing by 1,000. All 2009 coefficients are the "subregion annual total output emission rate."

Natural Gas Coefficients

The default values in the CACP model were used; they are the same as those used in 2005.

Transportation

We used the default assumptions for San Diego County within CARB's GHG emissions models, EMFAC2007 and OFFROAD2007 (from 2007) and EMFAC2011 (from 2011).

Solid Waste

The default values in the CACP model were used; they are the same as those used in 2005.

INPUTS AND METHODOLOGY

This section describes the data used to calculate 2011 emissions and the manner in which the data was acquired, transformed, and used. The 2005 emissions measurement process was organized

around source sector; this structure was maintained for the 2011 effort. The table at the end of this section compares the 2005 and 2011 inputs.

Residential / Commercial / Industrial (RCI)

The inputs for these three sectors are the same: inputs are electricity and natural gas consumed, broken into bundled and direct access, and entered into CACP. All of the data is from SDG&E.

- Bundled electricity is produced for SDG&E and transmitted by SDG&E. The electricity coefficients for SDG&E, based on the utility's mix of power sources and technology, determine the CO_2e produced.
- Direct access electricity is produced elsewhere in the region but ultimately transmitted to the consumer by SDG&E. Given the wide mix of possible producers, regional electricity coefficients are applied to determine CO_2e.
- Natural gas produces the same CO_2e regardless of source.

Table 4 shows the 2011 RCI inputs compared to the 2005 inputs. There were some changes between bundled and direct access service—see the data file for those details. Most energy consumption increased between 1.4 and 2.5 percent per year. The exceptionally high industrial natural gas consumption in 2005 appears to include use by the Encina Power Station, which was removed from the final numbers of that inventory; the 2011 Inventory data does not include the station.

Table 4: RCI Inputs

		2005	*2011*	*Change*	*Avg Annual*
Residential	Electric (kWh)	249,286,797	275,033,189	10%	1.7%
	Natural Gas (therms)	13,861,471	15,769,481	14%	2.2%
Commercial	Electric (kWh)	379,244,330	411,249,580	8%	1.4%
	Natural Gas (therms)	6,779,454	7,844,336	16%	2.5%
Industrial	Electric (kWh)	114,639,521	116,341,521	1%	0.2%
	Natural Gas (therms)	234,647,345*	1,536,470	-	-

*Includes use by Encina Power Station

Table 5 summarizes the communitywide consumption of electricity and natural gas. Electricity consumption grew at the rate of job creation and below the rate of population growth, but natural gas consumption grew faster than the city.

Table 5: Communitywide Summary of Electricity and Gas Consumption

	2005	*2011*	*Change*	*Avg Annual*
Electric (kWh)	743,170,648	802,624,290	8%	1.3%
Natural Gas (therms)*	20,640,925	23,613,817	14%	2.3%

*Excludes industrial

Transportation – Vehicles

The 2005 inventory used the EMFAC2007 model created by CARB due to its "regionally-specific information on the mix of vehicle classes and model years, as well as ambient conditions and travel speeds, that determine fuel efficiency." As inputs, emissions from local roadway VMT and freeway VMT were determined separately.

- Local roadway VMT was taken from the Caltrans HPMS (Highway Performance Monitoring System), which provides a citywide daily VMT for all local roadways except federal and state highways (i.e., I-5).
- Daily VMT for I-5 was acquired from SANDAG regional GIS files and clipped to the city limits.
- EMFAC2007 apparently produced CO_2 and CH_4 outputs in short tons (2,000 pounds) for each VMT, broken down by gasoline and diesel.
- CH_4 was converted into CO_2e by multiplying it by 21.
- Daily CO_2e was multiplied by 365 days and converted to metric tons, which are 1,000 kilograms, but multiplying "short tons" by 0.9072.
- The State highway CO_2e was also multiplied by 0.94 to convert weekday only data into average 7-day data.

For the 2011 inventory update, SANDAG provided 2008 and 2011 VMT data for two scenarios: the first which captures all VMT within the City of Carlsbad, the second excluding pass-through trips, or trips neither originating nor ending within the City of Carlsbad. Examples of pass-through trips are trips on the I-5 freeway and other major streets where drivers do not begin or end within the City of Carlsbad. Table 6 shows a comparison of VMT from 2005 and 2011 both including and excluding pass-through trips. In both 2005 and 2011, the VMT excluding pass-through trips was less than one-half of the total VMT.

Table 6: Annual Vehicle Miles Travelled within City of Carlsbad Including and Excluding Pass-Through Trips

	2005*	% of Total	2011	% of Total
VMT including pass-through trips	1,077,348,687	-	1,203,623,632	-
VMT excluding pass-through trips	505,241,237	47%	510,973,969	42%

*Estimated by linear interpolation of 2008 SANDAG data

The 2011 Inventory uses VMT excluding pass-through trips to capture transportation emissions from trips originating or ending within the City of Carlsbad. Residents, commuters and the City have a limited ability or are unable to influence pass-through trips, which contribute a substantial amount to VMT totals. Therefore, pass-through trips were excluded from this inventory.

Table 7 compares the 2005 annual VMT to 2011 VMT. The VMT in Carlsbad grew at a slower rate than population growth. The low rate of growth in VMT could have been caused by regional economic slowdown.

Table 7: Annual Vehicle Miles Travelled within City of Carlsbad Excluding Pass-Through Trips

	2005*	2011	Change	Avg Annual
VMT	505,241,237	510,973,969	1%	0.2%

*Estimated by linear interpolation from 2008 SANDAG data

The inventory update uses CARB's latest model, EMFAC2011, which is made up of three modules, -SG, -LDV, and –HD. The SG module covers all vehicle types, while LDV calculates light duty vehicles and HD calculates heavy duty vehicles.

- Carbon dioxide emissions were calculated using the SG module. The model was set to San Diego County, CY 2011, Annual, using the citywide annual VMT for 2011. We used the CO_2 emissions output that assumes Pavley I and low carbon fuel standard (LCFS).
- Methane emissions are not calculated by the SG module, so the LDV module was used to calculate CH_4 from light duty vehicles, with emissions from heavy duty vehicles calculated using a formula. We used the following process:
    - The SG module automatically distributes overall VMT into different vehicle types using a regionally-specific mix.
    - These SG vehicle types were compared to the vehicle models in the LDV module and manually categorized into light and heavy duty.
    - The VMT for light duty vehicles was then entered into the LDV module, which calculated CH_4 for light duty vehicles.
    - For heavy duty vehicles, we summed the Total TOG Emissions and multiplied by 0.0408 to get CH_4. Calculation is from CARB: http://www.arb.ca.gov/msei/emfac2011-faq.htm#emfac2011_web_db_qstn07

Transportation – Off Road

As with the 2005 inventory, CARB's OFFROAD2007 model was used. It was run with the settings: 2011 CY, Mon-Sun (all days), Annual, HC emissions as TOG, Area = San Diego County; all equipment, fuel, and horsepowers.

The model generates emission outputs for 16 categories across San Diego County. The 2005 inventory used 4 categories that generate the most emissions: lawn and garden equipment, construction equipment, industrial equipment, and light commercial equipment.

The CO2, N2O, and CH4 emissions are calculated in short tons per day for the county. These emissions were then pro-rated by the city's share of the county population, multiplied by 365 days, and converted to metric tons.

Solid Waste

For methane emissions from the one landfill in the city limits, the closed Palomar Airport Landfill, we used the same data from 2005 – it is unlikely to have changed much, if at all.

For emissions from solid waste disposed of in Carlsbad and taken to landfills elsewhere, 2011 data for Carlsbad was obtained from CalRecycle. The composition of waste was estimated from the latest such survey, the 2008 CalRecycle Statewide Waste Characterization Study, which has averages for the southern region of California. The amount of average daily cover, which is made of plant debris, was also entered.

Wastewater

As in 2005, the EPIC estimate of GHG emissions from countywide wastewater treatment was used and pro-rated to Carlsbad's share of the county population. For unknown reasons, countywide GHG emissions from wastewater treatment went up significantly from 2005 to 2011, increasing by 32 percent. While this emissions increase was not caused by Carlsbad per se, the community is considered responsible for it. That said, these emissions from wastewater make up a very small proportion of Carlsbad's overall GHG emissions.

OUTPUTS

The majority of emissions growth came from commercial and residential electricity and natural gas consumption, although this was highly influenced by the large increase in emissions from SDG&E electricity generation since 2005. Transportation emissions decreased by 5 percent, though VMT rose by 1 percent, likely a sign that cleaner vehicles are making an impact. Emissions from solid waste decreased along with the decline in the tonnage of waste disposed, possibly due to the economic recession, while emissions from wastewater treatment went up regionally but are a relatively small number. Table 8 summarizes the sources and amounts of communitywide emissions.

Table 8: GHG Emissions 2005 vs. 2011 (metric tons CO2e)

Sector	*Subsector*	*2005 Emissions*	*2011 Emissions*	*% Growth*	*Avg Annual Rate*
Residential	Bundled Electricity	62,105	92,500		
	Bundled Natural Gas	74,137	83,698		
	Direct Access Electricity	185	81		
	Direct Access Natural Gas	-	126		
	Total Residential	**136,427**	**176,405**	**29%**	**4.38%**
Commercial	Bundled Electricity	83,303	125,314		
	Bundled Natural Gas	35,843	37,731		
	Direct Access Electricity	15,049	11,701		
	Direct Access Natural Gas	416	3,966		
	Total Commercial	**134,611**	**178,712**	**33%**	**4.84%**
Industrial	Bundled Electricity	16,812	29,329		
	Bundled Natural Gas	3,013	-		
	Direct Access Electricity	15,605	8,765		
	Direct Access Natural	-	8,154		

	Gas				
	Total Industrial	**35,430**	**46,248**	**31%**	**4.54%**
Transportation	On-Road Total	260,467	239,467	-8%	-1.39%
	Lawn and Garden Equipment	2,099	2,449	17%	2.60%
	Construction Equipment	19,861	23,830	20%	3.08%
	Industrial Equipment	4,349	4,943	14%	2.16%
	Light Commercial Equipment	2,654	3,056	15%	2.38%
	Off-Road Subtotal	*28,963*	*34,279*	*18%*	*2.85%*
	Total Transportation	**289,430**	**273,745**	**-5%**	**-0.9%**
Solid Waste	Community-generated solid waste	27,417	21,719	-21%	-3.81%
	Landfill Waste-in-Place	2,598	2,598	0%	0.00%
	Total Solid Waste	**30,015**	**24,317**	**-19%**	**-3.45%**
Wastewater	Total Community-generated Wastewater	4,397	6,317	44%	6.23%
GRAND TOTALS		**630,310**	**705,744**	**12%**	**1.90%**

The RCI numbers in the above table can be hard to compare, due to growth in energy consumption being mixed with switches between bundled service and direct access. Table 9 summarizes emissions by power source and sector. From this table, it is clear that the relative and absolute increase in emissions from electricity is a major contributor to the communitywide growth in emissions.

Table 9: Emissions from Electricity and Natural Gas Summarized

Category	*2005 CO2e*	*2011 CO2e*	*% Growth*	*AARG*
Residential-Electric	62,290	92,581	49%	6.8%
Residential-NG	74,137	83,824	13%	2.1%
Commercial-Electric	98,352	137,015	39%	5.7%
Commercial-NG	36,259	41,697	15%	2.4%
Industrial-Electric	32,417	38,094	18%	2.7%
Industrial-NG	3,013	8,154	171%	18.0%
OVERALL RCI	**306,468**	**401,365**	**31%**	**4.6%**

CONCLUSIONS

Overall the communitywide GHG emissions from Carlsbad increased by 12 percent between 2005 and 2011, equivalent to the rate of population and job household growth during that time. As a result, the GHG emissions per service population held steady since 2005, as shown in Table 10.

Table 10: Emissions per Service Population

	2005	*2011*	*% Change*
GHG Emissions ($MTCO_2e$)	630,310	705,745	12.0%
Service Population	154,270	172,820	12.0%
Emissions per Service Population	4.09	4.08	-0.1%

Table 11 shows where the growth in emissions came from. The largest contributors to additional emissions came from commercial electricity usage (37%), followed by residential electricity usage (29%). All other emissions increased lower than the rate of population growth, with emissions from residential natural gas consumption increasing by 9 percent, and all other sources increasing by 5 percent, or decreasing, in the case of roadway emissions.

For electricity, this increase is largely fueled by the large increase (35%) in the CO_2 generated by SDG&E electricity since 2005. For example, residential electricity consumption increased by 10 percent but emissions from that source increased by 29 percent. Commercial electricity consumption went up by 8 percent while related emissions increased by 37 percent—an even higher increase as some commercial customers switched from cleaner direct access electricity to "dirtier" sources.

Table 11: Sources of Growth in GHG Emissions (metric tons CO2e)

Source	*2005 CO2e*	*2011 CO2e*	*Growth*	*% of Growth*
Commercial-Electric	98,352	137,015	38,663	37%
Residential-Electric	62,290	92,581	30,291	29%
Residential-NG	74,137	83,824	9,688	9%
Roads	260,467	239,467	-21,000	-8%
Industrial-Electric	32,417	38,093	5,676	5%
Commercial-NG	36,259	41,697	5,438	5%
Off Road	28,963	34,279	5,315	5%
Industrial-NG	3,013	8,154	5,141	5%
Wastewater	4,397	6,317	1,920	2%
Solid Waste	30,015	24,317	-5,698	-5%
TOTALS	**630,310**	**705,744**	**75,434**	

Table 12 shows the sources of emissions, ordered by volume of overall contribution. The largest contributor continues to be transportation, but that has declined in proportion as emissions from

energy consumption have grown faster. These sources—roadway VMT, off-road vehicles, and private electricity and natural gas consumption—account for 96 percent of Carlsbad's communitywide GHG emissions.

Table 12: Greenhouse Gas Emissions Summary by Sector (metric tons CO2e)

Sector	*2005*	*% of Total*	*2011*	*% of Total*
Transportation	289,431	46%	273,745	39%
Commercial / Industrial	170,041	27%	224,960	32%
Residential	136,427	22%	176,405	25%
Solid Waste	30,015	5%	24,317	3%
Wastewater	4,397	1%	6,317	1%
TOTAL	**630,310**		**705,744**	

DYETT & BHATIA
Urban and Regional Planners

M E M O R A N D U M

To: David de Cordova

From: Chris Ford

Re: Carlsbad Government Operations Greenhouse Gas Inventory Update – 2011

Date: June 18, 2013

This memo summarizes the approach taken to update the 2005 Greenhouse Gas (GHG) Emissions Inventory from City of Carlsbad government operations with 2011 data and compares the inputs and outputs. A separate memo covers community emissions, updated with 2011 data. That memo is referenced in this one to minimize repetition of information. The content of these memos will contribute to the summary of Carlsbad's GHG emissions in the forthcoming Climate Action Plan (CAP); the memos may be placed in an appendix to the CAP.

Technical terms and acronyms that appear in this memo are listed in Table 1.

Table 1: Technical Terms and Acronyms

CACP	Clean Air and Climate Protection software, a model developed by ICLEI to inventory and forecast GHG emissions
CAP	Climate Action Plan
CARB	California Air Resources Board, the agency responsible for setting statewide GHG emission reduction targets. CARB also maintains several GHG emission calculation models.
CO_2e	Carbon dioxide equivalents, a measure of GHGs that converts non-CO_2 emissions to the same impact as carbon dioxide
EPA	US Environmental Protection Agency
FTE	Full-Time Equivalent employees
GHG	Greenhouse gases, mainly carbon dioxide (CO_2), carbon dioxide, nitrous oxide (N_2O), and methane (CH_4)
ICLEI	An organization that provides standards and models for measuring and forecasting GHG emissions
SDG&E	San Diego Gas and Electric, the energy utility for Carlsbad
VMT	Vehicle Miles Traveled, a measure of the annual amount of driving within an area, used to calculate GHG emissions from vehicles

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ASSUMPTIONS

As with the 2005 inventory, ICLEI's CACP[1] model was used to estimate emissions from local government operations across all sectors. Unlike with community emissions, CACP was the only model employed.

Three sectors analyzed— employee commute, stationary refrigerants, and solid waste—are "Scope 3" emissions. These emissions are not part of the government operations emissions inventory as they are indirectly caused by the City, but this memo reports on their impact.

Employees

Between 2005 and 2011, the number of full-time equivalent (FTE) employees at the City of Carlsbad increased by 4.2 percent, growing from 793 to 826 FTE. This percent change is used to estimate pro-rated increases in certain emissions since 2005.

Electricity Coefficients

Electricity coefficients measure how much GHG emission and air pollution is created by various sources of electricity generation. The government operations inventory uses the same electricity coefficients as the community inventory; see that other memo for a discussion on the increase in GHG emissions per megawatt hour from SDG&E electricity since 2005.

Natural Gas Coefficients

The default values in the CACP model were used; they are the same as those used in 2005.

Transportation

Local government emissions from vehicles were estimated using the CACP model. For NO_2 and CH_4 emissions, CACP only includes emissions factors through model year 2005. The CACP instructions include additional factors that can be manually entered for model years 2006-2008; we also got newer information from the latest *US EPA Inventory of US GHG Emissions and Sinks* report, the source used by ICLEI. This 2013 version of the EPA report[2] includes newer emissions factors, although the applicable date is not specified; the factors for gasoline are similar to the 2008 factors, therefore they were applied for model years 2009 onwards. Table 2 shows the emissions factors we entered into CACP for gasoline vehicles with model years of 2006 and later.

Table 2: Emissions Factors from Gasoline Fueled Vehicles, Model Years 2006 On

Fuel	*Vehicle Type*	*Model Year*	*NO_2 factor*	*CH_4 factor*
Gasoline	Passenger car	2006	0.0057	0.0161
Gasoline	Passenger car	2007	0.0041	0.0170
Gasoline	Passenger car	2008	0.0038	0.0172

[1] The 2011 update utilized the CACP 2009 Version 3.0 software.
[2] We found the 2013 report, which includes newer factors in Annex 3 of the report, although the applicable date is not specified. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

Table 2: Emissions Factors from Gasoline Fueled Vehicles, Model Years 2006 On

Fuel	*Vehicle Type*	*Model Year*	*NO_2 factor*	*CH_4 factor*
Gasoline	Passenger car	2009+	0.0036	0.0173
Gasoline	Light trucks	2006	0.0089	0.0159
Gasoline	Light trucks	2007	0.0079	0.0161
Gasoline	Light trucks	2008	0.0066	0.0163
Gasoline	Light trucks	2009+	0.0066	0.0163
Gasoline	Heavy trucks	2006	0.0175	0.0326
Gasoline	Heavy trucks	2007	0.0173	0.0327
Gasoline	Heavy trucks	2008	0.0171	0.0327
Gasoline	Heavy trucks	2009+	0.0134	0.0333

Sources: 2006-08 model years from ICLEI Local Government Operations Inventory Instructions, referencing LGO Protocol table G.12: Based on U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008 (2010). 2009+ model years from EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011 (2013), Annex 3.

The 2013 EPA report's emissions factors for diesel are the same as for model years 1996-2004, so diesel vehicles were handled through the regular CACP calculation.

Solid Waste

The default values in the CACP model were used.

INPUTS AND METHODOLOGY

This section describes the data used to calculate 2011 emissions and the manner in which the data was acquired, transformed, and used. The table at the end of this section compares the 2005 and 2011 inputs.

Buildings and Other Facilities

The inputs for this sector are electricity and natural gas. Data was entered by individual facility with departmental information also entered. Since the 2005 inventory through 2011, a number of new or expanded facilities have been added to the City's operations: Fire Station No. 6, Senior Center expansion, Recycled Water Facility, Aviara Community Park, Hidden Canyon Park, Pine Avenue Park, The Crossings golf course, and the Hawthorne Equipment Building. During the same period, the Library Learning Center replaced the Adult Learning Center and Centro de Informacion. These additional facilities account for the majority of the change in electricity and natural gas consumption.

Table 3 lists all of the buildings and facilities operated by the city, comparing electricity and natural gas inputs between 2005 and 2011. Overall, the City's facilities consumed 21 percent more electricity and 10 percent more natural gas in 2011 compared to 2005.

Table 3: Building and Facilities Inputs

Department	Building	2005 Electricity (kWh)	2005 Natural gas (therms)	2011 Electricity (kWh)	2011 Natural gas (therms)	% Change Electricity (kWh)	% Change Natural gas (therms)
City	City Administration	1,099,520	1,430	1,203,726	1,738	9%	22%
City	City Hall	294,080	8,552	233,680	5,313	-21%	-38%
City	Farmers Insurance Bldgs	167,055	71	112,057	-	-33%	-100%
City	Hawthorne Equipment Bldg	N/A	N/A	10,040	-		N/A
City Total		**1,560,655**	**10,053**	**1,559,503**	**7,051**	**0%**	**-30%**
Community Development	Hiring Center	6,299	-	6,972	-	11%	
Community Development	Las Palmas	22,720	-	55,570	-	145%	
Community Development Total		**29,019**		**62,542**		**116%**	**-**
Fire	Fire Station No. 1	85,720	900	63,600	1,358	-26%	51%
Fire	Fire Station No. 2	29,847	676	32,643	1,069	9%	58%
Fire	Fire Station No. 3	33,713	525	33,972	675	1%	29%
Fire	Fire Station No. 4	31,434	544	28,867	1,062	-8%	95%
Fire	Fire Station No. 5	108,560	2,231	98,720	2,061	-9%	-8%
Fire	Fire Station No. 6	N/A	N/A	55,180	1,464	-	N/A
Fire Total		**289,274**	**4,876**	**312,982**	**7,689**	**8%**	**58%**
Golf Course	The Crossings			**1,056,015**	**18,019**	**-**	**-**
Library	Adult Learning Center	9,078	-	-	-	-	-
Library	Cole Library	454,560	3,835	430,160	2,119	-5%	-45%
Library	Cultural Arts Department	17,506	381	14,444	321	-17%	-16%
Library	Dove Library	1,288,533	15,487	1,432,492	11,200	11%	-28%
Library	Library Learning Center	32,960	766	192,000	421	483%	-45%
Library Total		**1,802,637**	**20,469**	**2,069,096**	**14,061**	**15%**	**-31%**
PD/Fire	Safety Center	**1,163,336**	**20,845**	**988,001**	**19,816**	**-15%**	**-5%**
Public Works	City Yard	100,861	474	88,335	729	-12%	54%
Public Works	CMWD M&O	197,920	754	189,440	86	-4%	-89%
Public Works	Fleet Yard	72,640	1,158	72,320	456	0%	-61%
Public Works	Parks Maintenance	29,474	117	39,694	149	35%	27%
Public Works Total		**400,895**	**2,503**	**389,789**	**1,420**	**-3%**	**-43%**
Recreation	Calavera Community Center	70,318	-	54,970	-	-22%	-
Recreation	Carrillo Ranch	58,320	-	58,080	-	0%	-
Recreation	Harding Community Center	76,040	1,063	60,120	952	-21%	-10%

Table 3: Building and Facilities Inputs

Department	Building	2005 Electricity (kWh)	2005 Natural gas (therms)	2011 Electricity (kWh)	2011 Natural gas (therms)	% Change Electricity (kWh)	% Change Natural gas (therms)
Recreation	Parks Total	773,551	2,122	914,888	3,006	18%	42%
Recreation	Senior Center	224,100	6,319	308,318	3,349	38%	-47%
Recreation	Stagecoach Community Center	215,360	1,602	195,920	1,424	-9%	-11%
Recreation	Swim Complex	202,520	31,116	247,240	34,266	22%	10%
Recreation	Trails	7,115	-	65,929	-	827%	-
Recreation Total		**1,627,324**	**42,222**	**1,905,465**	**42,997**	**17%**	**2%**
Housing and Neighborhood Services		**22,736**	**-**	**31,277**	**-**	**38%**	**-**
TOTALS		**6,895,876**	**100,968**	**8,374,670**	**111,053**	**21%**	**10%**

Public Lighting

This sector covers electricity consumed from three sources: traffic signals, streetlights, and other outdoor lighting. As shown in Table 4, streetlights make up the great majority of electricity consumption in this sector. Between 2005 and 2011, this sector consumed 4 percent less electricity, with the small increase in traffic signal and controller use more than offset by the declines in streetlight and outdoor lighting consumption. During this period, the city retrofitted its existing streetlights with more energy-efficient lamps.

Table 4: Public Lighting Inputs (kWh)

	2005	% of Total	2011	% of Total	% Change
Streetlights	4,652,801	86%	4,403,265	85%	-5%
Traffic Signals/Controllers	750,417	14%	768,784	15%	2%
Outdoor Lighting	20,988	0%	17,740	0%	-15%
TOTALS	**5,424,206**		**5,189,789**		**-4%**

Water and Wastewater Transport

This sector covers fuel consumed by pumps and other mechanisms used to convey water and wastewater: water delivery pumps, sprinklers and irrigation, sewage pumps, and recycled water pump stations. These systems all consumed electricity plus a small amount (170 gallons) of diesel fuel for water delivery generators.

Table 5 shows the electricity consumed by the City's water and wastewater transport systems in 2005 and 2011. During that time, electricity used by these systems increased by 29 percent. Much of that change can be attributed to a major increase in electricity used by recycle pump stations, as the city's recycled water facility came online in late 2005. Sewage pumps also used significantly more electricity (22% increase), as did sprinklers and irrigation (72% increase)

although the amount was comparatively small. Water delivery pumps actually decreased in electricity consumption by 21 percent.

Table 5: Waste and Wastewater Transport Inputs (kWh)

	2005	*% of Total*	*2011*	*% of Total*	*% Change*
Recycle Pump Stations	418,980	23%	791,732	34%	89%
Sewage Pumps	1,038,941	57%	1,262,824	53%	22%
Water Delivery Pumps	360,237	20%	285,345	12%	-21%
Sprinklers/Irrigation	13,151	1%	22,554	1%	72%
TOTALS	**1,831,309**		**2,362,455**		**29%**

Vehicle Fleet

The inputs for this sector are all the vehicles used by the City. The key data used are fuel consumed and VMT, broken out by model year, vehicle type, and fuel type. CACP uses fuel consumption to calculate CO_2 emissions and VMT to calculate NO_2 and CH_4 emissions.

Although the vehicle fleet data from the City was broken down by department, the inputs were loaded into CACP as a single set for the entire City due to the time consuming nature of processing and entering this very detailed information.

Table 6 summarizes the inputs in 2005 and 2011 by vehicle and fuel type. There likely was some different categorization in terms of vehicle types in 2005, especially between light and heavy trucks, but overall fuel consumed and VMT by fuel type should be comparable. While there was a notable increase in diesel consumption and VMT, this was more than offset by a sharp decline in gasoline consumption and VMT.

Table 6: Vehicle Fleet Inputs

	2005		***2011***		***% Change***	
	Fuel (gal)	*VMT*	*Fuel (gal)*	*VMT*	*Fuel (gal)*	*VMT*
Diesel	**54,589**	**284,526**	**62,407**	**407,826**	**14%**	**43%**
Light Truck/SUV/Pickup	8,443	87,570	31,162	298,388		
Heavy Truck	46,146	196,956	31,245	109,438		
Gasoline	**207,286**	**2,580,657**	**167,345**	**1,965,416**	**-18%**	**-24%**
Passenger Car	99,396	1,487,843	85,874	931,979		
Motorcycle	2,374	N/A	1,787	74,024		
Light Truck/SUV/Pickup	88,329	982,401	76,663	938,733		
Heavy Truck	17,187	110,413	3,021	20,680		
Hybrid	**-**	**-**	**3,581**	**137,096**		
Passenger Car			2,478	108,136		
Light Truck/SUV/Pickup			1,103	28,960		

For the analysis in CACP, motorcycle inputs were grouped under passenger cars and hybrid fuel consumption was included with gasoline. Hybrid VMT was assumed at one-third of listed mileage to account for the likely reality of most hybrid miles being under electric power during low speed driving on local streets.

Mobile Refrigerants

Refrigerants come from stationary and mobile sources. Stationary sources are described under Scope 3 emissions.

Mobile source refrigerants come from estimated leakage from the vehicle fleet. The 2005 inventory undertook a very complex and thorough analysis based on attributes of each vehicle in the fleet, using the make, model, year, and time in service to determine refrigerant type and capacity and calculate estimated emissions. Ultimately, the GHG emissions from mobile refrigerants made up less than one percent of government operations emissions in 2005.

Given the small impact of these mobile refrigerants and the time already invested in the 2005 analysis, we used the 2005 output and pro-rated it for 2011 based on the relative sizes of the vehicle fleet. The 2005 fleet had 264 vehicles compared to 291 vehicles in the 2011 fleet, a 10 percent increase. Therefore, we estimated a 10 percent increase in GHG emissions from mobile sources for 2011.

Scope 3 Emissions

These emissions are not part of the government operations inventory as they are indirectly caused by the City.

Employee Commute

The City conducted an employee commute survey in 2009 which was applied to the 2005 inventory. Given that only two years elapsed between the survey and the year of this GHG emissions inventory update, it was assumed that the mode split, fuel consumption, and VMT data from the survey were still applicable. As with the 2005 inventory, the results from usable survey responses were extrapolated to apply to all City FTE. Since the 2011 FTE is 4.2 percent higher than the 2005 FTE, the fuel usage and VMT inputs for 2011 were 4.2 percent higher than in 2005.

Stationary Refrigerants

Stationary sources come from equipment installed in facilities. The 2005 inventory identified refrigerants used to service equipment in five buildings: Las Palmas, Harding Community Center, City Administration, the Safety Center, and the Senior Center. The 2011 inventory identified refrigerant use in four buildings: City Administration, City Hall, Dove Library, and the Senior Center. Refrigerants use was less in 2011 than in 2005, by around half (117.50 kg compared to 234.51 kg).

Solid Waste

The City undertook a thorough evaluation of solid waste generated by City facilities in 2005. Given that solid waste generation is typically correlated to number of people, we pro-rated

the amount of solid waste based on the increase in FTE between 2005 and 2011, which was 4.2 percent.

Sectors Not Considered

The City does not operate port, airport, wastewater, or solid waste facilities, provide transit services, or generate electric power.

CONCLUSIONS

City operations in 2011 generated an estimated 8,205 metric tons CO_2e in GHG emissions, compared to an estimated 6,556 metric tons CO_2e in 2005, an increase of 25 percent, as shown in Table 7. City operations still accounted for a very small proportion of the GHG emissions from Carlsbad in 2011, making up 0.8 percent of emissions, the same as in 2005.

Table 7: Government Operations Emissions – 2005 vs. 2011 (metric tons CO_2e)

	2005	*2011*	*% Change*
Total emissions	6,556	8,205	25.2%
Carlsbad - Service Population	154,270	172,820	12.0%
Community emissions	925,248	1,030,353	11.4%
Government operations as proportion of community emissions	0.7%	0.8%	13.1%

The rate of growth in government emissions between 2005 and 2011 was higher than the rates of increase in Carlsbad's service population (12.0%) and communitywide GHG emissions (11.4%). The main reasons for the increase in government operations emissions appear to be twofold:

- A sharp increase in electricity consumed by water and wastewater transport services, especially recycled water pumps; and
- More emissions from electricity per megawatt hour, an issue that also affected communitywide emissions and further discussed in that memo.

Emissions by Sector

Emissions for government operations mainly came from buildings and facilities (42%) and the vehicle fleet (27%), followed by public lighting (21%) and water and wastewater transportation (10%), as shown in Table 8.

Compared to 2005, the proportion of city government emissions from buildings and facilities increased from 35 percent to 42 percent, increasing by 50 percent and making up more than two-thirds of the growth in emissions. As explained above, this is largely due to the opening of new buildings and recreation facilities since 2005.

Meanwhile, compared to 2005, the proportion of emissions from lighting and water/wastewater transport stayed largely the same, but the actual emissions from these sectors grew by 29 percent and 72 percent, respectively. Note that public lighting emissions

increased by despite that sector consuming 4 percent less electricity in 2011 compared to 2005. This outcome is a result of the much greater amount of emissions produced per megawatt hour of electricity in 2011 compared to 2005.

Meanwhile, vehicle fleet emissions decreased by 9 percent during the same period, due to major decreases in the miles driven and gallons of gasoline consumed.

Table 8: Emissions by Sector (metric tons CO_2e)

Source	*2005*	*% of Total*	*2011*	*% of Total*	*2005 to 2011 Increase*	*% Growth*	*% of Growth*
Buildings and Facilities	2,266	35%	3,410	42%	1,144	50%	69%
Vehicle Fleet	2,474	38%	2,253	27%	-221	-9%	-13%
Public Lighting	1,354	21%	1,747	21%	393	29%	24%
Water and Wastewater Transport	461	7%	795	10%	334	72%	20%
TOTALS	**6,556**		**8,205**		**1,650**	**25%**	

Emissions by Source

Most of the government operations emissions in 2011 came from electricity consumption, accounting for 65 percent of emissions, an increase from 59 percent in 2005. GHG emissions from electricity increased by 52 percent between 2005 and 2011, as shown in Table 9. Electricity was the source of almost all of the increase in emissions—more than the total increase, in fact, but offset by the decline in emissions from gasoline. Emissions from gasoline dropped by 17 percent, which caused gasoline to decline from 31 to less than 19 percent of government operation emissions between 2005 and 2011. Emissions from diesel grew by 13 percent and from natural gas and mobile refrigerants by 10 percent each, although all from relatively small bases.

Table 9: Emissions by Source (metric tons CO_2e)

Source	*2005*	*% of Total*	*2011*	*% of Total*	*2005 to 2011 Increase*	*% Growth*	*% of Growth*
Electricity	3,534	58.7%	5,362	65.4%	1,828	52%	111%
Gasoline	1,853	30.8%	1,538	18.7%	-315	-17%	-19%
Diesel / Propane	566	9.4%	641	7.8%	75	13%	5%
Natural Gas	537	8.9%	590	7.2%	53	10%	3%
Mobile Refrigerants	67	1.1%	74	0.9%	7	10%	0%
TOTALS	**6,557**		**8,205**		**1,648**	**25%**	

Sector 3 Emissions

Employee commute and solid waste emissions were estimated for 2011 based on pro-rating various indicators and loading them into the CACP model for calculation. See the Assumptions section above for more details.

- Employee commute emissions were estimated at 2,567 metric tons CO_2e in 2011, compared to 2,417 metric tons CO_2e in 2005, an increase of 6.2 percent.
- Stationary refrigerant emissions were estimated at 173 metric tons CO_2e in 2011, compared to 399 metric tons CO_2e in 2005, a decrease of 57 percent.
- Solid waste emissions were estimated at 144 metric tons CO_2e in 2005, the same as in 2011.

Appendix C

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Appendix D

Applicable General Plan Policies

Chapter 2: Land Use and Community Design

2-P.22 Build and operate commercial uses in such a way as to complement but not conflict with adjoining residential areas. This shall be accomplished by:

a. Controlling lights, signage, and hours of operation to avoid adversely impacting surrounding uses.
b. Requiring adequate landscaped buffers between commercial and residential uses.
c. Providing bicycle and pedestrian links between commercial centers and surrounding residential uses, and providing bicycle-parking racks.
d. Ensuring building mass does not adversely impact surrounding residences.

2-P.23 Ensure that commercial development is designed to include:

a. Integrated landscaping, parking, signs, and site and building design
b. Common ingress and egress, safe and convenient access and internal circulation, adequate off-street parking and loading facilities. Each commercial site should be easily accessible by pedestrians, bicyclists, and automobiles to nearby residential development.
c. Architecture that emphasizes establishing community identity while presenting tasteful, dignified and visually appealing designs compatible with their surroundings.
d. A variety of courtyards and pedestrian ways, bicycle facilities, landscaped parking lots, and the use of harmonious architecture in the construction of buildings

2-P.43 Evaluate each discretionary application for development of property with regard to the following specific criteria:

a. Site design and layout of the proposed buildings in terms of size, height and location, to foster harmony with landscape and adjacent development.
b. Site design and landscaping to provide buffers and screening where appropriate, conserve water, and reduce erosion and runoff.
c. Building design that enhances neighborhood quality, and incorporates considerations of visual quality from key vantage points, such as major transportation corridors and intersections, and scenic vistas.

d. Site and/or building design features that will reduce greenhouse gas emissions over the life of the project, as outlined in the Climate Action Plan.
e. Provision of public and/or private usable open space and/or pathways designated in the Open Space, Conservation, and Recreation Element.
f. Contributions to and extensions of existing systems of streets, foot or bicycle paths, trails, and the greenbelts provided for in the Mobility, and Open Space, Conservation, and Recreation elements of the General Plan.
g. Compliance with the performance standards of the Growth Management Plan.
h. Development proposals which are designed to provide safe, easy pedestrian and bicycle linkages to nearby transportation corridors.
i. Provision of housing affordable to lower and/or moderate-income households.
j. Policies and programs outlined in Local Coastal Program where applicable.
k. Consistency with applicable provisions of the Airport Land Use Compatibility Plan for McClellan-Palomar Airport.

2-P.44 Require new residential development to provide pedestrian and bicycle linkages, when feasible, which connect with nearby shopping centers, community centers, parks, schools, points of interest, major transportation corridors and the Carlsbad Trail System.

2-P.45 At the time existing shopping centers are renovated or redeveloped, where feasible, require connections to existing residential neighborhoods through new pedestrian pathways and entrances, mid-block crossings, new or wider sidewalks, and pedestrian-scaled street lighting.

2-P.46 Enhance walkability on a citywide scale by installing benches and transit shelters and adding landscaping, wayfinding and pedestrian-scaled lighting. Consider ways to improve rail and freeway overpass/ underpass areas, with lighting, sidewalk improvements and art installations.

2-P.48 Improve beach access through a variety of mechanisms, including:

a. In the Village and adjacent areas, identify the primary pedestrian connections and entrances to the beach through signage, a consistent landscaping scheme, change in paving materials, wider sidewalks and preservation of view corridors. Identify opportunities for additional access points as improved connectivity and facilities are provided, particularly if new beachfront activity areas are established.
b. In the Barrio neighborhood, provide a pedestrian crossing under or over the rail corridor at Chestnut Avenue.
c. Identify and implement more frequent pedestrian crossings along Carlsbad Boulevard. Identify and prioritize crossings from residential neighborhoods and existing bicycle and pedestrian trails.

For more detailed policies on pedestrian and bicycle movement, see Chapter 3: Mobility.

2-P.51 Plan and design Carlsbad Boulevard and adjacent public land (Carlsbad Boulevard coastal corridor) according to the following guiding principles:

a. Carlsbad Boulevard shall become more than a road. This transportation corridor shall provide for recreational, aesthetic and community gathering opportunities that equal the remarkable character of the land.
b. Community safety shall be a high priority. Create destination that provides a safe public environment to recreate.
c. Strategic public access and parking is a key to success. Development shall capitalize on opportunities to add/enhance multiple public access points and public parking for the beach and related recreational amenities.
d. Open views are desirable and important to maintaining the character of the area. Preservation and enhancement of views of ocean, lagoons, and other water bodies and beaches shall be a high priority in road, landscaping, and amenity design and development.
e. Enhance the area's vitality through diversity of recreational land uses. Carlsbad Boulevard development shall provide for amenities, services and goods that attract a diversity of residents and visitors.
f. Create vibrant and sustainable public spaces. Development shall provide for unique and vibrant coastal gathering spaces where people of all age groups and interests can gather to enjoy recreational and environmental amenities and supporting commercial uses.
g. Connect community, place and spirit. Design shall complement and enhance connectivity between existing community and regional land uses.
h. Environmentally sensitive design is a key objective. Environmentally sensitive development that respects existing coastal resources is of utmost importance.
i. A signature scenic corridor shall be created through design that honors the coastline's natural beauty. The resulting improvements will capture the 'essence' of Carlsbad; making it a special place for people from throughout the region with its natural beauty and vibrant public spaces. Properly carried out, the realigned boulevard will maximize public views and encourage everyone to slow down and enjoy the scenery.
j. Reimagining of Carlsbad Boulevard shall be visionary. The reimagined Carlsbad Boulevard corridor will incorporate core community values articulated in the Carlsbad Community Vision by providing: a) physical connectivity through multi-modal mobility improvements including bikeways, pedestrian trails, and a traffic-calmed street; b) social connectivity through creation of memorable public spaces; and c) economic vitality through a combination of visitor and local-serving commercial, civic, and recreational uses and services.

2-P.68 Enhance the walkability and pedestrian orientation of the Village, including along Carlsbad Village Drive, to enhance the small, beach town atmosphere and improve access to and utilization of transit.

2-P.71 Address parking demand by finding additional areas to provide parking for the Village and beach areas, and by developing creative parking management strategies, such as shared parking, maximum parking standards, "smart" metering, utilizing on-street parking for re-use of existing buildings, etc.

2-P.75 Create a cohesive, pedestrian-scale streetscape that includes improved sidewalks, streetscape, signage and way-finding, and which celebrates the Barrio's heritage and provides better connections between the Barrio and Village and across the railroad at Chestnut Avenue.

2-P.79 West of the railroad tracks:

- Decommission, demolish, remove and remediate the Encina Power Station site, including the associated structures, the black start unit and exhaust stack according to the provisions of a settlement agreement dated January 14, 2014, between and among the City of Carlsbad and the Carlsbad Municipal Water District (CMWD), Cabrillo Power I LLC and Carlsbad Energy Center LLC, and San Diego Gas and Electric Company (SDG&E).
- The desalination plant shall remain on approximately 11 acres (six acres for the desalination plant and approximately five acres of non-exclusive easements) west of the railroad tracks.
- Redevelop the Encina Power Station site, along with the SDG&E North Coast Service Center site, with a mix of visitor-serving commercial uses, such as retail and hotel uses, and with new community-accessible open spaces along Agua Hedionda Lagoon and the waterfront (Carlsbad Boulevard). Encourage community gathering spaces, outdoor dining, and other features to maximize potential views of the ocean and the lagoon. Encourage shared parking arrangements so that a greater proportion of development can be active space rather than parking.
- Determine specific uses, development standards, infrastructure, public improvements, site planning and amenities through a comprehensive planning process (e.g., specific plan, master plan, etc.) resulting in a redevelopment plan approved by the City Council. The redevelopment plan boundaries should include the Encina Power Station and the SDG&E North Coast Service Center sites.
- Work with SDG&E to identify a mutually acceptable alternative location for Its North Coast Service Center. Work with SDG&E, as part of a long-term plan, to identify and ultimately permit an alternate site for its Encina substation.

2-P.85 Allow small pockets of higher density residential at the edges of the corridor, as shown on the Land Use Map, to enable residents to live closer to jobs, with opportunities for enhanced bicycle and pedestrian paths that link residential and employment uses. Ensure that residential uses incorporate noise attenuation criteria in accordance with the Airport Land Use Compatibility Plan.

Chapter 3: Mobility

3-P.6 Utilize transportation demand management strategies, non-automotive enhancements (bicycle, pedestrian, transit, train, trails, and connectivity), and traffic signal management techniques as long-term transportation solutions and traffic mitigation measures to carry out the Carlsbad Community Vision.

3-P.11 Evaluate implementing a road diet to three lanes or fewer for existing four-lane streets currently carrying or projected to carry 25,000 average daily traffic volumes or less in order to promote biking, walking, safer street crossings, and attractive streetscapes.

3-P.12 Design new streets, and explore funding opportunities for existing streets, to minimize traffic volumes and/or speed, as appropriate, within residential neighborhoods without compromising connectivity for emergency first

responders, bicycles, and pedestrians consistent with the city's Carlsbad Active Transportation Strategies. This should be accomplished through management and implementation of livable streets strategies and such programs like the Carlsbad Residential Traffic Management Plan.

3-P.13 Consider innovative design and program solutions to improve the mobility, efficiency, connectivity, and safety of the transportation system. Innovative design solutions include, but are not limited to, traffic calming devices, roundabouts, traffic circles, curb extensions, separated bicycle infrastructure, pedestrian scramble intersections, high visibility pedestrian treatments and infrastructure, and traffic signal coordination. Innovative program solutions include, but are not limited to, webpages with travel demand and traffic signal management information, car and bike share programs, active transportation campaigns, and intergenerational programs around schools to enhance safe routes to schools. Other innovative solutions include bicycle friendly business districts, electric and solar power energy transportation systems, intelligent transportation systems, semi- or full autonomous vehicles, trams, and shuttles.

3-P.15 Encourage Caltrans, SANDAG, NCTD, and adjacent cities to improve regional connectivity and service consistent with regional planning efforts. This includes expansion of Interstate-5 with two HOV lanes in each direction and associated enhancements, a Bus Rapid Transit (BRT) route along Palomar Airport Road, shuttle bus services from COASTER stations, and other enhancements to improve services in the area.

3-P.16 Engage Caltrans, the Public Utilities Commission, transit agencies, the Coastal Commission, and railroad agency(s) regarding opportunities for improved connections within the city, including:

- Improved connections across the railroad tracks at Chestnut Avenue and other locations
- Completion and enhancements to the Coastal Rail Trail and/or equivalent trail along the coastline
- Improved connectivity along Carlsbad Boulevard for pedestrians and bicyclists, such as a trail
- Improved access to the beach and coastal recreational opportunities
- Improved crossings for pedestrians across and along Carlsbad Boulevard

3-P.17 Implement connections and improvements identified in this Mobility Element, including those identified in policy 3-P.15, as well as:

- Extension of College Boulevard from Cannon Road to El Camino Real
- Completion of the Poinsettia Lane connection near El Camino Real (Reach E)
- Extension of Camino Junipero to the eastern city boundary
- A bicycle/pedestrian trail/pathway connecting the eastern terminus of Marron Road to the east
- A bicycle/pedestrian trail/pathway connecting the eastern terminus of Cannon Road to the east, and coordination with adjacent agencies to appropriately link to their facilities

3-P.18 Support pedestrian and bicycle facilities at all Interstate-5 and State Route 78 interchanges.

3-P.20 Update the pedestrian, trails and bicycle master plans, as necessary, to reflect changes in needs, opportunities and priorities.

3-P.21 Implement the projects recommended in the pedestrian, trails and bicycle master plans through the city's capital improvement program, private development conditions and other appropriate mechanisms.

3-P.22 Identify and implement necessary pedestrian improvements on pedestrian-prioritized streets with special emphasis on providing safer access to schools, parks, community and recreation centers, shopping districts, and other appropriate facilities.

3-P.23 Implement the Safe Routes to School and Safe Routes to Transit programs that focus on pedestrian and bicycle safety improvements near local schools and transit stations. Prioritize schools with access from arterial streets for receiving Safe Routes to School projects.

3-P.24 Improve and enhance parking, connectivity, access, and utilization for pedestrians and bicycles to COASTER stations, utility corridors, and open spaces consistent with city planning documents.

3-P.25 Evaluate incorporating pedestrian and bicycle infrastructure within the city as part of any planning or engineering study, private development, or capital project where bicyclists or pedestrians are a prioritized or non-prioritized mode.

3-P.27 Engage the community in the policy setting and planning of street, bicycle, pedestrian, transit, and connectivity studies, plans and programs.

3-P.28 Require developers to improve pedestrian and bicycle connectivity consistent with the city's bicycle and pedestrian master plans and trails master planning efforts. In addition, new residential developments should demonstrate that a safe route to school and transit is provided to nearby schools and transit stations within a half mile walking distance.

3-P.29 Work with existing neighborhoods and businesses to improve pedestrian and bicycle connectivity and safety consistent with the city's pedestrian and bicycle master plans and trails master planning efforts.

3-P.30 Actively pursue grant programs such as SANDAG's Active Transportation Grant Program and Smart Growth Incentive Program to improve non-automotive connectivity throughout the city. The emphasis of grant-funded projects shall be on implementation, which includes planning documents that guide and prioritize implementation, programs that encourage the use of active transportation modes, education for the use of active transportation modes, or physical improvements themselves.

3-P.31 Partner with other agencies and/or developers to improve transit connectivity within Carlsbad. As part of a comprehensive transportation demand management (TDM) strategy and/or with transit oriented development (TOD), a shuttle system could be established that connects destinations and employment centers like LEGOLAND, hotels, the Village, McClellan-Palomar Airport, business parks, the COASTER and Breeze transit stations, and key destinations along the coast. The system could incorporate shuttle service in adjacent cities to maximize connectivity.

3-P.32 Encourage NCTD, SANDAG and other transit providers to provide accessibility for all modes of travel to the McClellan-Palomar Airport area.

3-P.34 Develop flexible parking requirements to provide the "right amount" of on-site vehicle parking. Such requirements will include implementation of innovative parking techniques, implementing effective TDM programs to reduce parking demand, and consideration of other means to "right size" the parking supply.

3-P.35 Require new employment development to provide secure bicycle parking on-site. Major employers should provide shower and changing rooms for employees as appropriate.

3-P.36 Assist Village businesses to manage parking in the Village area to maximize parking efficiency. Any potential parking-related revenues generated in this area should be reinvested into the Village area for implementing livable streets and other parking, pedestrian, and bicycle enhancements, including way-finding signage and maintenance of associated infrastructure.

3-P.37 Consider supporting new development and existing businesses with various incentives (such as parking standards modifications) for implementing TDM programs that minimize the reliance on single-occupant automotive travel during peak commute hours.

Chapter 4: Open Space, Conservation, and Recreation

4-P.39 Prepare a comprehensive Trails Master Plan update, that expands the existing and planned 61-mile trail system, with the following objectives:

- Connectivity between off-road trails and major on-road pedestrian and bicycle routes, such that future improvements in the trail system also contribute to linkages between important sites (beaches, lagoons, schools, commercial centers, master planned communities, and others)
- Design and designate trails as multi-use to be accessible for all user groups, including walkers, bicyclists, and equestrians (as land use policy allows). Ensure that the network provides an appropriate amount of resources for each trail type or user group
- Greenway and trail linkages from major recreational/open space areas to other land use areas or activities, including, but not limited to, residential neighborhoods, places of employment, parks, schools, libraries, and viewpoints

- Linkages/multi-use trails connecting businesses and residential neighborhoods to the beaches

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